

BIOSYSTEMATIC STUDIES IN THE
ARTEMISIA MARITIMA COMPLEX
IN EUROPE

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TABLES AND FIGURES

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Table 1. Artemisia maritima. Frequencies of different chromosome numbers found in root-tip metaphases.

	Chromosome number						Number of plants
	50	51	52	53	54	55	56
% counted plates in the entire material	1.1	1.9	11.1	10.1	69.1	5.4	1.3
% plants in the entire material with a given number in at least one plate	1.2	2.3	13.0	13.1	74.2	7.4	1.9
% non-aneusomatic plants within the non-aneusomatic material	1.1	1.7	10.5	8.1	74.0	3.8	0.8
in the entire material	1.0	1.5	9.2	7.1	64.6	3.3	0.7
% aneusomatic plants with a given number in at least one plate	1.7	6.0	30.2	47.4	75.9	32.8	9.5
within the aneusomatic material	0.2	0.8	3.8	6.0	9.6	4.1	1.2
in the entire material							116

Table 2. Artemisia maritima. Percentage of euploid, aneuploid and aneusomatic plants in different parts of the area of distribution. The figures within parentheses represent the number of populations in which euploids etc. have been found.

	Euploids	Aneuploids	Aneusomatics	Number of populations
Öland--Gotland (Sweden)	60.3 (13)	22.2 (7)	17.5 (11)	13
Bohuslän--Halland (Sweden)	64.9 (16)	21.9 (14)	13.2 (11)	17
Skåne (Sweden), N. Germany, Danish islands, SE. Jylland(Denmark)	65.2 (30)	23.5 (17)	11.3 (15)	30
N. Jylland (Denmark)--Netherlands	64.3 (33)	23.3 (27)	12.4 (20)	35
W. France	55.2 (6)	31.0 (5)	13.8 (4)	7
Great Britain	76.9 (7)	15.4 (4)	7.7 (2)	7
Artern (Germany)	83.3 (1)	8.3 (1)	8.3 (1)	1
Total	64.6 (106)	22.7 (75)	12.7 (64)	110

Table 3. Artemisia maritima. Percentage of aneuploids and aneusomatics in flowering and non-flowering material during three years of cultivation.

Year	1	2	3
Flowering material	18.8	38.0	26.4
Non-flowering material	39.0	41.0	39.5

Table 4. Artemisia maritima. Male meiotic disturbances in some aneuploid and aneusomatic plants.

Plant no.	2n	First division (anaphase I-- telophase I)			Second division (anaphase II-- telophase II)		
		Number of disturbed divisions	Number of normal divisions	Percentage of disturbed divisions	Number of disturbed divisions	Number of normal divisions	Percentage of disturbed divisions
9-3-1	53, 55	38	775	4.7	23	276	7.7
14-5-1	51	8	191	4.0	27	230	10.5
25-5-1	53, 54	3	173	1.7	3	100	2.9
47-4-1	52	4	85	4.5	13	578	2.2
52-4-2	53	5	71	6.6	2	101	1.9
87-3-2	52, 54	17	343	4.7	11	617	1.8
130-2-1	53	29	446	6.1	36	347	9.4

Table 5. Artemisia maritima. Number of satellites per chromosome set in parent and F_1 plants of some crosses.

Cross	♀	♂	F_1
33-3-1 x 33-4-3	0 sat	1 sat	3 plants with 0 sat
			6 plants with 1 sat
47-1-1 x 5-3-2	0 sat	0 sat	14 plants with 0 sat
59-5-2 x 19-2-1	1 sat	0 sat	6 plants with 0 sat
			4 plants with 1 sat

Table 6. Flowering periods of Artemisia maritima, A. vallesiaca and A. santonicum.

	Flowering period in cultivation	Flowering period in nature
<u>A. maritima</u>		
Öland--Gotland (Sweden)	August	August
Bohuslän (Sweden)	End of September	September
Ostfriesland (Germany)	Beginning of September	End of August--beg. of Sept.
Arteln (Germany)	End of Sept.--October	September--beginning of Oct.
<u>A. vallesiaca</u>	End. of Sept.--October	September--beginning of Oct.
<u>A. santonicum</u>		
diploids (Austria, Czechoslovakia)	Middle of Sept.--beg. of Oct.	Middle of Sept.--middle of Oct.
tetraploids (Hungary, Roumania)	Middle of Sept.--beg. of Oct.	Middle of Sept.--beg. of Oct.
hexaploids (Greece)	October	First half of October

Table 7. Artemisia maritima. Nine grand populations are each compared with the rest of the material, as to the number of characters in which the mean value of the population is significantly different.

Grand population	Number of comparisons in which the population is significantly (xx and xxx) different			Number of characters for which the the population is significantly (xx and xxx) different from ≥ 4 other populations
	Vegetative characters	Floral characters	Total	
A	16	21	37	4
B	13	18	31	3
C	22	26	48	8
D	26	28	54	8
E	11	18	29	3
F	8	22	30	4
G	12	15	27	2
H	10	18	28	4
J	22	18	40	4

Table 8. Artemisia santonicum. Morphological characters of the three cytotypes compared. The most obvious similarities are underlined.

Diploids and tetra- ploids similar	Diploids and hexa- ploids similar	Tetraploids and hexaploids similar	All different
Pubescence	<u>Shoot length</u>	<u>Leaf segmentation</u>	Length of leaf lamina
<u>Length of synflor- escence/shoot length</u>	<u>Corolla length/ corolla lobe length</u>	<u>Breadth of leaf segment</u>	Shape of leaf lamina
Length of style branch		<u>Shape of leaf segment</u>	Corolla length
		<u>Stomatal length</u>	Number of glands per floret
		<u>Branch rigidity</u>	
		<u>Density of capitula</u>	
		<u>Position of capitula</u>	
		<u>Peduncle length</u>	
		Phyllary breadth	
		Number of florets per capitulum	
		Shape of corolla lobe	
		Theca length	
		Pollen diameter	

Table 9. Length of stomatal guard cells in leaves of Artemisia santonicum (A) and A. maritima (B--E) seedlings after cultivation for five weeks in a nutrient solution without and with 1 % NaCl, respectively. Mean value and standard deviation are given.

Achene coll.	Length of guard cells in leaves of seedlings after 5 weeks in nutrient solution		Length of guard cells in leaves of plants cultivated in soil under uniform conditions
	without NaCl	with 1 % NaCl	
A	23.8 $\pm$ 1.5 μ	21.4 $\pm$ 1.5 μ	22.6 $\pm$ 2.1 μ
B	36.1 $\pm$ 2.1 μ	32.2 $\pm$ 1.7 μ	34.3 $\pm$ 3.8 μ
C	41.1 $\pm$ 3.3 μ	31.0 $\pm$ 3.4 μ	36.1 $\pm$ 3.5 μ
D	36.1 $\pm$ 2.4 μ	31.8 $\pm$ 1.7 μ	33.3 $\pm$ 3.7 μ
E	35.5 $\pm$ 2.6 μ	31.9 $\pm$ 2.1 μ	34.1 $\pm$ 3.3 μ

Table 10. The sodium chloride concentrations giving optimal development of seedlings at three stages. The numbers within parentheses represent the salt concentrations at which growth wholly stagnates.

Age of seedlings at beginning of experiment	A. santonicum		A. maritima		
	A	B	C	D	E
Newly-developed	0.1 % (1 %)	0.05 % (0.1--0.5 %)	0--0.1 % (0.5 %)	0--0.05 % (0.5 %)	0.05--0.1 % (0.5 %)
4 weeks	0 % (1.5 %)	0 % (1.5 %)	?	?	?
8 weeks	0.1--0.2 % (1.5 %)	0.05--0.2 % (2 %)	0--0.05 %	0--0.2 % (2 %)	0--0.1 % (2--3 %)

Table 11. The average salinity of the sea water at surface level within the area of investigation (after Hyltén 1950).

Coast	Average salinity
B South-western Skåne (Sweden)	0.8--1.0 %
C Öland (Sweden)	0.6--0.7 %
D Southern Bohuslän (Sweden)	2.2--2.6 %
E Nordfriesland (Germany)	3.2--3.3 %

Table 12. Crosses within Artemisia maritima. The first figure in each square indicates the number of crosses, the second indicates the number of crosses that produced well-developed achenes, and the third indicates the number of F_1 families obtained.

	Skåne (Sweden)	Halland (Sweden)	Bohuslän (Sweden)	Öland/Gotland (Sweden)	N.E. Jylland (Denmark)	S.W. Jylland (Denmark)	Nordfriesland (Germany)	Ostfriesland (Germany)	The Netherlands	N.W. France	E. England	W. England	Artern (Germany)
Skåne (Sweden)		6-0-0	7-2-1	12-2-2	2-1-1	2-0-0	3-2-1	7-3-1	-	2-0-0	2-0-0	2-1-1	3-0-0
Halland (Sweden)	6-2-0		6-4-1	6-2-0	1-0-0	1-0-0	4-0-0	3-1-1	-	-	-	-	-
Bohuslän (Sweden)	7-3-1	6-6-1		6-4-1	2-0-0	5-1-1	3-0-0	3-2-1	-	-	-	-	-
Öland/Gotland (Sweden)	12-3-1	6-4-1	6-4-3		1-0-0	4-0-0	5-0-0	3-0-0	2-1-1	-	-	-	-
N.E. Jylland (Denmark)	2-2-2	1-0-0	2-2-0	1-0-0		2-2-2	-	-	-	-	-	-	-
S.W. Jylland (Denmark)	2-0-0	1-0-0	5-2-0	4-0-0	2-2-1		-	-	-	-	-	-	1-0-0
Nordfriesland (Germany)	3-0-0	4-0-0	3-0-0	5-0-0	-	-		3-2-2	-	-	-	-	1-0-0
Ostfriesland (Germany)	7-3-0	3-0-0	3-0-0	3-0-0	-	-	3-2-1	-	-	2-0-0	2-1-1	2-0-0	2-0-0
The Netherlands	-	-	-	2-0-0	-	-	-	-	-	-	-	-	-
N.W. France	2-0-0	-	-	-	-	-	-	2-0-0	-	2-0-0	2-1-1	-	-
E. England	2-0-0	-	-	-	-	-	-	2-1-1	-	2-0-0	1-1-1	-	-
W. England	2-1-1	-	-	-	-	-	-	2-0-0	-	2-1-1	1-1-1	-	-
Artern (Germany)	3-0-0	-	-	-	1-0-0	1-0-0	3-0-0	2-1-1	-	-	-	-	-

Table 13. Crosses within Artemisia maritima. Seed set after crossing, and germination of achenes obtained. The figures within parentheses represent the number of experiments producing achenes and germination of achenes respectively.

Crossing combination ♀ x ♂	Total number of achenes obtained	Germination		Number of days from sowing till 50 % of final germination
		Number of achenes	%	
Skåne x Bohuslän	20 (2)	5 (1)	25.0	15
x Gotland	31 (2)	8 (2)	25.8	13.5
x N.E. Jylland	12 (1)	7 (1)	58.3	12
x Nordfriesland	32 (2)	21 (1)	65.7	9
x Ostfriesland	64 (3)	18 (1)	28.1	7
x W. England	77 (1)	58 (1)	75.3	9
Halland x Skåne	22 (2)	0	0	-
x Bohuslän	108 (4)	22 (1)	20.4	6
x Gotland	43 (2)	0	0	-
x Ostfriesland	28 (1)	4 (1)	14.3	17
Bohuslän x Skåne	45 (3)	4 (1)	8.9	20
x Halland	149 (6)	30 (1)	20.1	8
x Gotland	108 (4)	18 (1)	16.7	21
x S.W. Jylland	28 (1)	3 (1)	10.7	6
x Ostfriesland	42 (2)	4 (1)	9.5	23
Gotland x Skåne	24 (3)	2 (1)	8.3	14
x Halland	30 (4)	4 (1)	13.3	10
x Bohuslän	181 (3)	8 (3)	4.4	37.7
Öland x Bohuslän	1 (1)	0	0	-
x the Netherlands	6 (1)	5 (1)	83.3	12
N.E. Jylland x Skåne	76 (2)	40 (2)	52.6	6
x Bohuslän	27 (2)	0	0	-
x S.W. Jylland	48 (2)	39 (2)	81.3	8

Table 13, continued.

Crossing combination ♀ x ♂	Total number of achenes obtained	Germination		Number of days from sowing till 50 % of final germination
		Number of achenes	%	
S.W. Jylland x Bohuslän	25 (2)	0	0	-
x N.E. Jylland	36 (2)	14 (1)	38.9	14
Nordfriesland x Ostfriesland	31 (2)	21 (2)	67.7	23
Ostfriesland x Skåne	79 (3)	0	0	-
x Nordfriesland	22 (2)	13 (1)	59.1	8
x E. England	175 (1)	84 (1)	48.0	22
N.W. France x W. England	48 (1)	32 (1)	66.7	10
E. England x Ostfriesland	35 (1)	30 (1)	85.7	22
x W. England	18 (1)	15 (1)	83.3	10
W. England x Skåne	3 (1)	3 (1)	100	20
x N.W. France	97 (1)	82 (1)	82.5	11
x E. England	11 (1)	7 (1)	63.6	26
Artern x Ostfriesland	5 (1)	3 (1)	60.0	21

Table 14. Crosses within Artemisia maritima. Flowering and mortality of F₁ plants.

Crossing combination		Original number of F ₁ plants	Second year		Third year		Fourth year		Fifth year		Total			
♀ x ♂	Number of flower- plants		Number of dead plants	Number of flower- plants	Number of dead plants	Number of flower- plants	Number of dead plants	Number of flower- plants	Number of dead plants	Flowering plants		Dead plants		
										No.	%		No.	%
Skåne x Bohuslän		5	0	0	1	0	-	-	-	-	1	20.0	0	0
x Gotland		8	0	2	0	1	0	2	0	2	0	0	7	87.5
x N.E. Jylland		7	1	0	2	0	1	1	2	0	2	28.6	1	14.3
x Ostfriesland		8	3	0	0	2	0	1	0	1	3	37.5	4	50.0
x W. England		10	4	0	1	1	-	-	-	-	5	50.0	1	10.0
Halland x Bohuslän		11	5	1	1	1	3	1	4	1	7	63.6	4	36.4
x Ostfriesland		4	0	0	1	0	0	0	1	0	1	25.0	0	0
Bohuslän x Skåne		4	0	0	0	0	0	0	0	0	0	0	0	0
x Halland		20	8	3	6	0	3	0	5	5	9	45.0	8	40.0
x Gotland		18	10	0	6	1	5	2	6	2	12	66.7	5	27.8
x Ostfriesland		4	4	0	4	0	1	0	2	0	4	100	0	0
Gotland x Skåne		2	2	0	2	0	0	0	1	1	2	100	1	50.0
x Bohuslän		8	1	1	4	1	1	0	5	1	6	75.0	3	37.5
Öland x the Netherlands		5	1	0	1	1	-	-	-	-	1	20.0	1	20.0
N.E. Jylland x Skåne		39	23	0	13	1	18	3	6	5	28	71.8	9	23.1

Table 14, continued.

Crossing combination		Original number of F ₁ plants	Second year		Third year		Fourth year		Fifth year		Total		
♀	♂		Number of flower. plants	Number of dead plants	Number of flower. plants	Number of dead plants	Number of flower. plants	Number of dead plants	Number of flower. plants	Number of dead plants	Flowering plants No.	Dead plants No.	%
Nordfriesland x Ostfriesl.		10	9	0	6	0	8	0	8	1	9	90.0	1 10.0
Ostfriesland x E. England		7	4	1	-	-	-	-	-	-	4	57.1	1 14.3
N.W. France x W. England		7	5	0	-	-	-	-	-	-	5	71.4	0 0
E. England x Ostfriesland		8	2	1	-	-	-	-	-	-	2	25.0	1 12.5
x W. England		10	4	1	-	-	-	-	-	-	4	40.0	1 10.0
W. England x Skåne		2	1	0	-	-	-	-	-	-	1	50.0	0 0
x N.W. France		7	4	1	-	-	-	-	-	-	4	57.1	1 14.3
x E. England		5	2	0	-	-	-	-	-	-	2	40.0	0 0
Artern x Ostfriesland		3	2	0	-	-	-	-	-	-	2	66.7	0 0

Table 15. Crosses within Artemisia maritima. Pollen fertility in hybrids (mean values) and their parents. The figures within parentheses represent the range of variation within each F_1 family.

Crossing combination ♀ x ♂	Chromosome number ♀	Percentage stainable pollen			Chromosome number ♂
		♀	F_1	♂	
Skåne x Bohuslän	51--54	76	64	74	52--53
x N.E. Jylland	54	87	82 (80--84)	76	54
x Ostfriesland	54	85	76 (72--81)	82	54
x W. England	52	87	84 (79--88)	81	54
Halland x Bohuslän	54	88	90 (79--98)	87	54--56
x Ostfriesland	54	88	51	74	54--55
Bohuslän x Halland	54--56	87	72 (49--91)	88	54
x Gotland	52	71	88 (75--99)	78	54
x Ostfriesland	54--56	87	56 (32--76)	62	55--56
Gotland x Skåne	54	78	71 (62--79)	90	52--54
x Bohuslän	54	78	81 (75--87)	71	52
x "	54	74	72 (60--84)	87	54
x "	53--54	84	64	89	54
Öland x the Netherlands	52--54	95	71	91	54
N.E. Jylland x Skåne	54	76	70 (49--89)	87	54
Nordfriesland x Ostfriesl.	54--55	79	86 (57--98)	93	54
Ostfriesland x E. England	55--56	62	81 (79--82)	89	54
N.W. France x W. England	52	78	82 (80--84)	94	54
E. England x Ostfriesland	54	89	84 (83--85)	62	55--56
x W. England	54	87	89 (87--95)	82	54
W. England x Skåne	54	81	64	87	52
x N.W. France	54	94	93 (90--95)	78	52
x E. England	54	82	88 (86--90)	87	54
Artern x Ostfriesland	54	97	82 (75--89)	98	54

Table 16. Crosses within Artemisia maritima. Chromosome numbers obtained from different crossing combinations.

Chromosome numbers of parents ♀ x ♂	Chromosome numbers of crossing products (Number of plants)									
	51/52	52	52/53	52/54	53	53/55	54	54/55	54/56	55
52 x 54	-	1	-	1	3	-	2	-	-	-
52/54 x 54	-	-	-	-	1	-	1	1	-	-
53 x 54	-	-	-	-	2	-	2	-	-	-
53/54 x 54	-	-	1	-	-	-	-	1	1	-
54 x 52	-	2	-	-	1	-	2	1	-	1
54 x 52/54	-	1	-	-	-	-	-	-	-	-
54 x 53/54	-	-	-	-	1	-	5	-	-	1
54 x 54	-	-	-	-	-	-	15	-	-	-
54 x 54/56	1	-	-	-	-	-	2	-	-	1
54/55 x 53/54	-	-	-	-	-	-	1	-	-	2
54/55 x 54	-	-	-	-	-	-	2	-	-	-
54/56 x 54	-	-	-	-	1	1	-	-	-	1
54/56 x 55/56	-	-	1	-	-	-	2	-	-	-
% plants with a given number	1.6	6.5	3.2	1.6	14.5	1.6	54.8	4.8	1.6	9.7

Table 17. Crosses within Artemisia maritima. Seed set after vibating within the F₁ generation and germination of achenes obtained. The figures within parentheses represent the variation in germination of achenes from different F₁ plants.

Crossing combination ♀ x ♂	Number of F ₁ plants used in crossing	Number of F ₁ plants yielding achenes	Total number of achenes obtained	Germination		Number of days from sowing till 50 % of final germination
				Number of achenes	%	
Skåne x N.E. Jylland	2	1	30	17	56.7	13
Bohuslän x Gotland	8	6	863	533	61.8 (57--84)	14.2 (8--17)
x Ostfriesland	4	2	4	3	75.0 (50--100)	8.5 (6--11)
Gotland x Skåne	2	1	5	4	80.0	11
x Bohuslän	3	1	4	1	25.0	23
N.E. Jylland x Skåne	10	9	1278	1149	89.9 (71--95)	5.9 (5--9)
Nordfriesland x Ostfriesl.	9	7	365	239	65.5 (47--88)	19.7 (17--22)

Table 18. Crosses within Artemisia maritima. Pollen fertility of parent, F_1 and F_2 plants of a cross between two populations from Bohuslän and Gotland (no. 47 x 5).

		Stainable pollen										
		0	10	20	30	40	50	60	70	80	90	100 %
No. of plants	P	-	-	-	-	-	-	-	2	-	-	
	F_1	-	-	-	-	-	-	-	3	3	4	
	F_2	1	2	1	1	3	10	9	13	9	-	

Table 19. Artemisia maritima ssp. maritima. Survey of the morphological characters of the form series.

Form series	West Swedish	Baltic	North Sea
Shoot length	(15--30--50(--60) cm	(20--30--50 cm	20--40 cm
Suffrutescence	(moderate--strong	moderate--strong	moderate(--strong)
Pubescence	dense (greyish-white --white)	moderate (greyish- green--grey)	moderate--rather dense (grey-- greyish-white)
Branch length	3--10(--15) cm	5--15(--20) cm	(3--5--10(--15) cm
Shape of leaf segment	elongate, spatulate	elongate, linear-- slightly spatulate	relatively short-- rather elongate, linear--slightly spatulate
Breadth of leaf segment	0.5--0.9(--1.0) mm	0.4--0.6(--0.7) mm	0.4--0.7 mm
Synflorescence	moderately--richly branched	moderately--richly branched	moderately branched
Capitulum length	(4--5--6 mm	4--5 mm	3.5--5 mm
Size of inner phyllaries	(3.2--3.4--4.5 mm x 1.5--2.2 mm	(3.0--3.4--4.0 mm x 1.3--2.0 mm	(3.0--3.2--4.0 mm x (1.0--1.2--1.9(--2.0) mm
Number of florets per capitulum	5--9(--11)	4--9(--11)	3--7
Corolla lobes	broadly triangular	somewhat elongate- triangular	somewhat elongate- triangular
Achene size	1.8--2.6 mm x 0.9--1.4 mm	1.6--2.6 mm x 0.8--1.2 mm	1.9--2.8 mm x 0.8--1.3 mm

Table 19, continued.

Form series	French	British	Inland
Shoot length	(15--20--40(--50) cm	(20--25--40(--50) cm	(20--30--60 cm
Suffrutescence	moderate--rather strong	moderate--rather strong	moderate--strong
Pubescence	moderate--dense (grey--whitish)	moderate(--rather dense) (greyish-green--grey)	sparse--moderate (dull green--greyish-green)
Branch length	(1--3--10(--15) cm	3--15(--20) cm	5--15(--20) cm
Shape of leaf segment	relatively short, (linear--spatulate	relatively short, linear--somewhat spatulate	relatively short--rather elongate, linear--slightly spatulate
Breadth of leaf segment	(0.5--0.6--0.9(--1.2) mm	0.5--0.8(--1.2) mm	0.5--0.7 mm
Synflorescence	moderately branched	moderately--richly branched	moderately branched
Capitulum length	3.5--5(--6) mm	3.5--5(--6) mm	(3.5--4--5 mm
Size of inner phyllaries	(3.1--3.5--4.1(--4.5) mm x (1.2--1.4--2.0(--2.2) mm	3.2--4.0(--4.2) mm x (1.2--1.4--1.8(--2.0) mm	(3.0--3.2--4.0 mm x (1.0--1.3--2.0(--2.2) mm
Number of florets per capitulum	3--6(--8)	3--7	3--7(--11)
Corolla lobes	slightly elongate--or equilaterally triangular	somewhat elongate--or equilaterally triangular	slightly elongate--or equilaterally triangular
Achene size	1.8--2.5 mm x 0.9--1.2(--1.3) mm	1.8--2.4 mm x 0.8--1.2 mm	1.9--2.4 mm x 0.8--1.2 mm

Table 20. Pollen diameter and ploidy level in species within the Artemisia maritima complex. Chromosome numbers counted by the author are marked (!).

	Number of herbarium specimens investigated	Pollen diameter	Ploidy level	Chromosome number (2n)
A. maritima	247	(18--)20--25(--27) μ	hexaploid!	54!
A. vallesiaca	78	(16--)18--22(--23) μ	tetraploid!	36!
A. santonicum	82	(14--)17--20 μ	diploid!	18!
	71	(19--)21--23(--26) μ	tetraploid!	36!
	13	(20--)22--25(--30) μ	hexaploid!	54!
A. caerulescens	49	(18--)19--21(--22) μ	diploid!	18!
A. gallica	74	(18--)19--21(--22) μ	diploid!	18!
A. lerchiana	15	20--24 μ	tetraploid?	36 Tītōvā 1935, Mīrūōkō 1961
A. taurica	9	17--20 μ	diploid (or tetraploid)?	18 Kāwātānī & Ōhō 1964
A. nitrosa	8	18--21 μ	diploid or tetraploid?	18 Kāwātānī & Ōhō 1964
A. fragrans	11	20--23 μ	tetraploid?	36 Ibid.
A. pauciflora	14	16--20 μ	diploid?	? (18 Kāwātānī & Ōhō 1964)
				18 Tītōvā 1935, Kāwātānī & Ōhō 1964

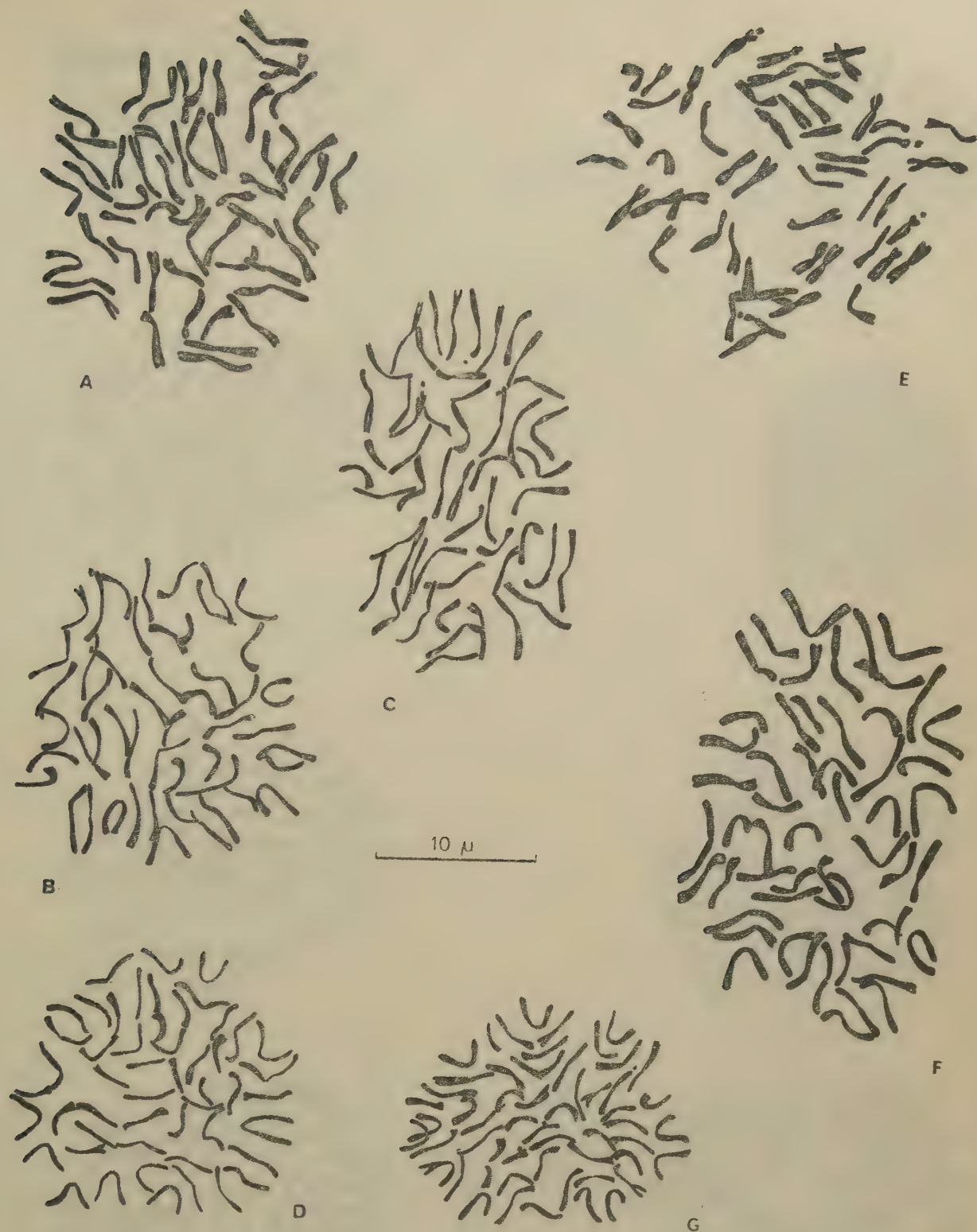


Fig. 1. *Artemisia maritima*. Root-tip mitoses (E: squash, A--D, F--G: microtome-cut preparations) in euploid (A) and aneuploid (B--G) plants. Localities: A: Essex, England (no. 152-2-1), $2n=54$. -- B: Nordfriesland, Germany (no. 70-3-1), $2n=50$. -- C: south-western Jylland, Denmark (no. 31-2-2), $2n=51$. -- D: Fehmarn, Germany (no. 122-2-1), $2n=52$. -- E: Artern, Germany (no. 124-5-1), $2n=53$. -- F: Norfolk, England (no. 155-4-1), $2n=55$. -- G: Bohuslän, Sweden (no. 89-10-3), $2n=56$.



Fig. 2. *Artemisia maritima*. Root-tip mitoses (microtome-cut preparations) in aneusomatic plants. Localities: A: north-eastern Jylland, Denmark (no.58-4-3), $2n=53$, 52. -- B: northern Sjaelland, Denmark (no. 26-4-2), $2n=54$, 52. -- C: north-eastern Jylland, Denmark (no. 59-6-2), $2n=54$, 55. -- D: Butjadingen, Germany (no. 72-2-2), $2n=54$, 56 (the number of the upper plate in each pair is mentioned first).

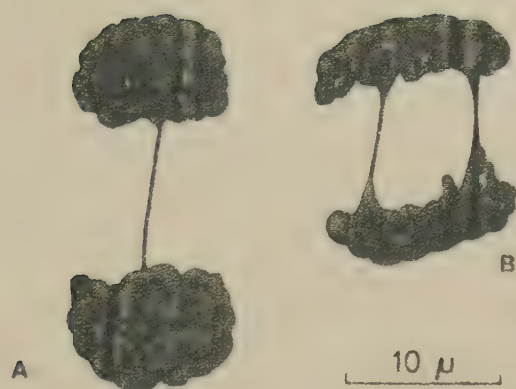


Fig. 3. *Artemisia maritima*. Disturbances in root-tip mitoses in aneusomatic plants.
 -- A: no. 46-3-2. -- B: no. 133-1-1.

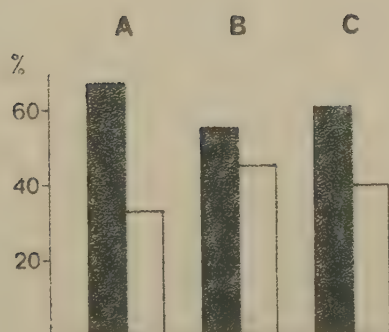


Fig. 4. *Artemisia maritima*. Percentage of flowering (black bars) and non-flowering (white bars) plants within euploid (A), aneuploid (B) and aneusomatic (C) material during one year of cultivation.

Fig. 5. Artemisia maritima. Irregular meiosis in aneuploid and aneusomatic plants. -- A: metaphase I. -- B--H: anaphase --telophase I. -- I--J: metaphase II. -- K--L: télophage II. -- Plant numbers: A--D, G--I, K--L: no. 9-3-1 ($2n=52$ --55). E--F: no. 87-3-2 ($2n=52, 54$). J: no. 14-5-1 ($2n=52$). -- X1750.

Fig. 6. Artemisia maritima. Irregular meiosis in aneuploid plants. The tetrad. -- Plant numbers: A--F: no. 14-5-1 ($2n=52$). -- X1750.

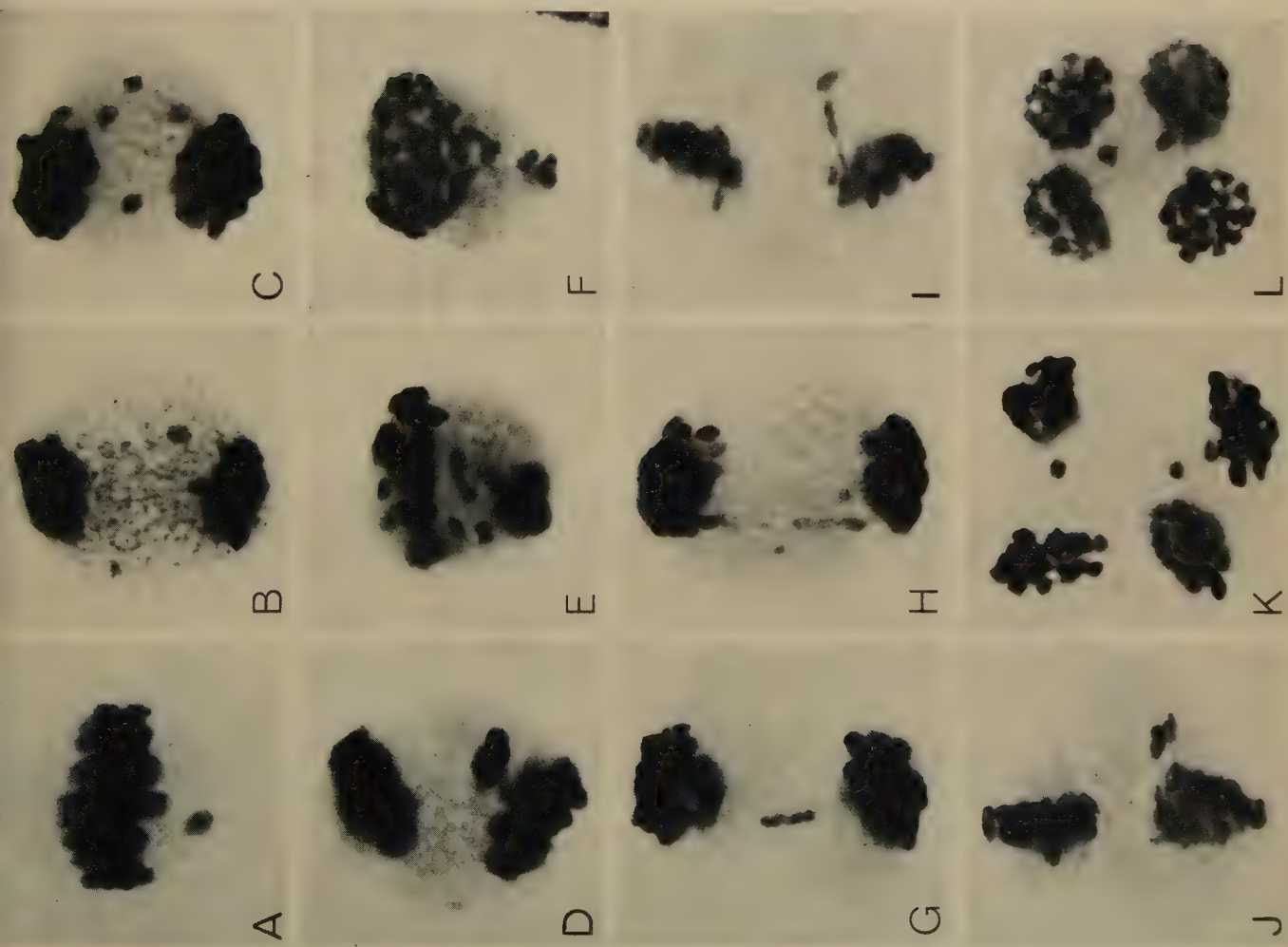


Fig. 5.

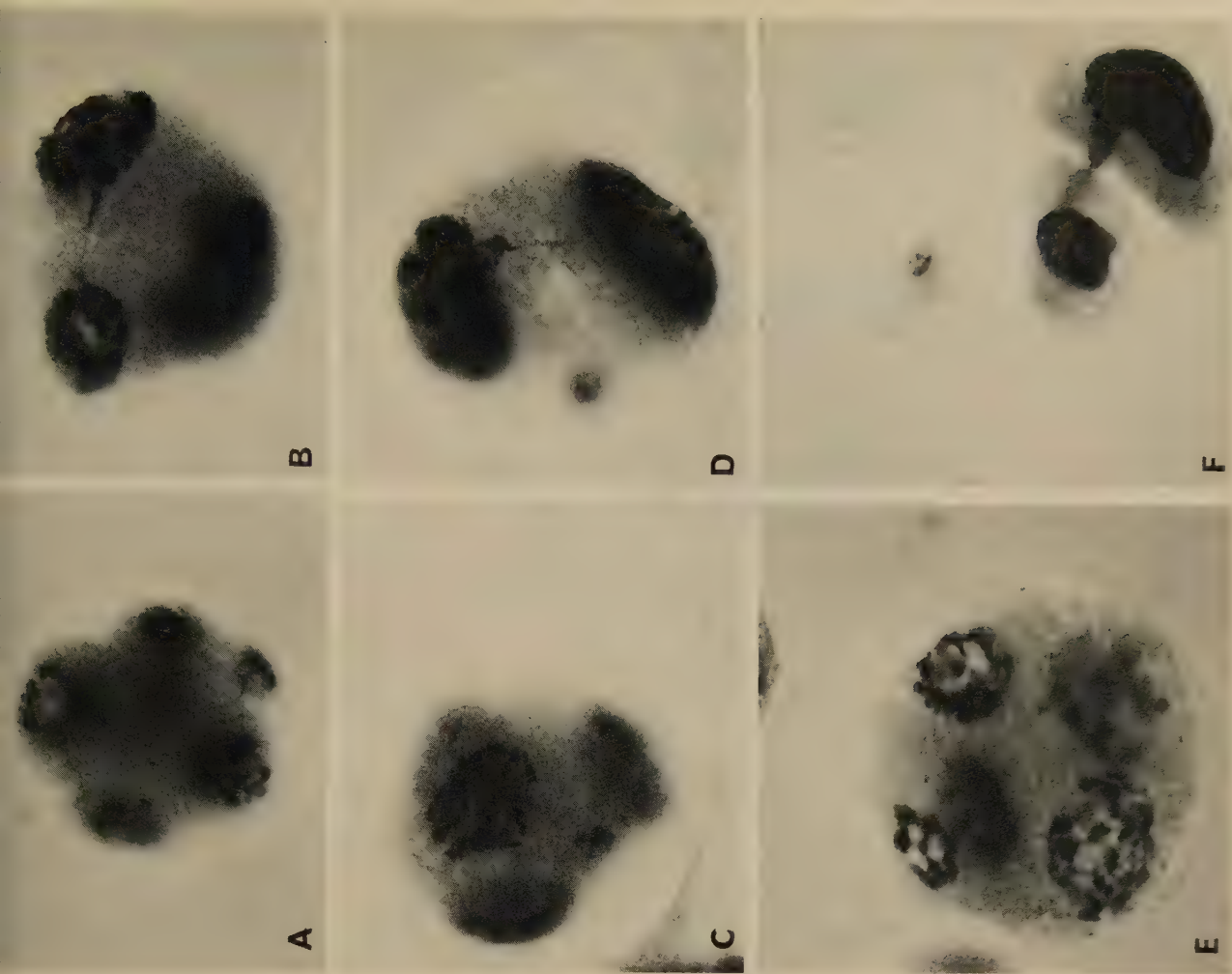


Fig. 6.

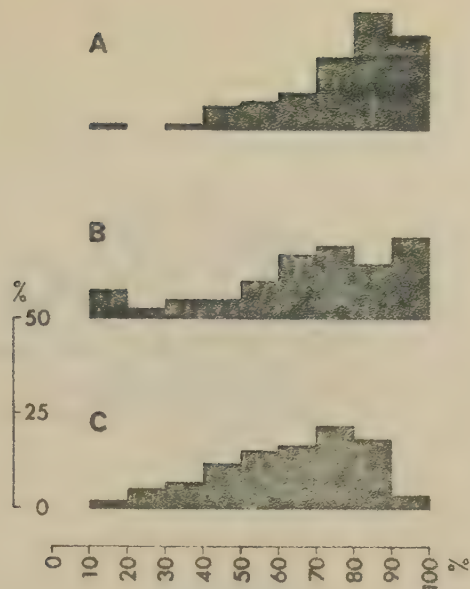


Fig. 7. *Artemisia maritima*. Frequencies of stainable pollen grains. -- A: euploid plants. -- B: aneusomatic plants containing euploid cells. -- C: aneuploid and aneusomatic plants. -- On vertical axis percentage of plants.



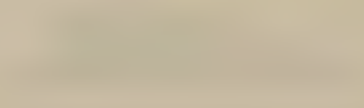
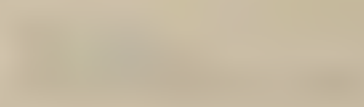
A

10 μ



B

Fig. 8. *Artemisia maritima*. Karyotype. -- A: no. 25-5-2 (Sjaelland, Denmark). -- B: no. 55-5-1 (Halland, Sweden).



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10 μ

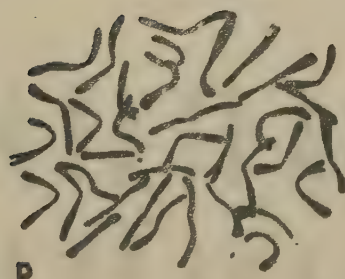


Fig. 9. Artemisia vallesiaca. Root-tip mitoses
(microtome-cut preparations) with $2n=36$.
Localities: A: Valais, Switzerland (no.
105-10-1). -- B: Valais, Switzerland (no.
106-2-1). -- C: Piemonte, Italy (no. 111-
10-1). -- D: Piemonte, Italy (no. 112-7-1).

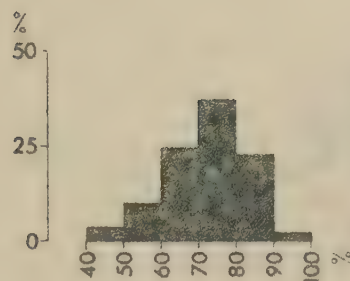


Fig. 10. Artemisia vallesiaca. Frequencies of stainable pollen grains. -- On vertical axis percentage of plants.



Fig. 11. Artemisia vallesiaca. Karyotype. -- A: no. 107-20-1, B: no. 109-29-1 (both Valais, Switzerland).

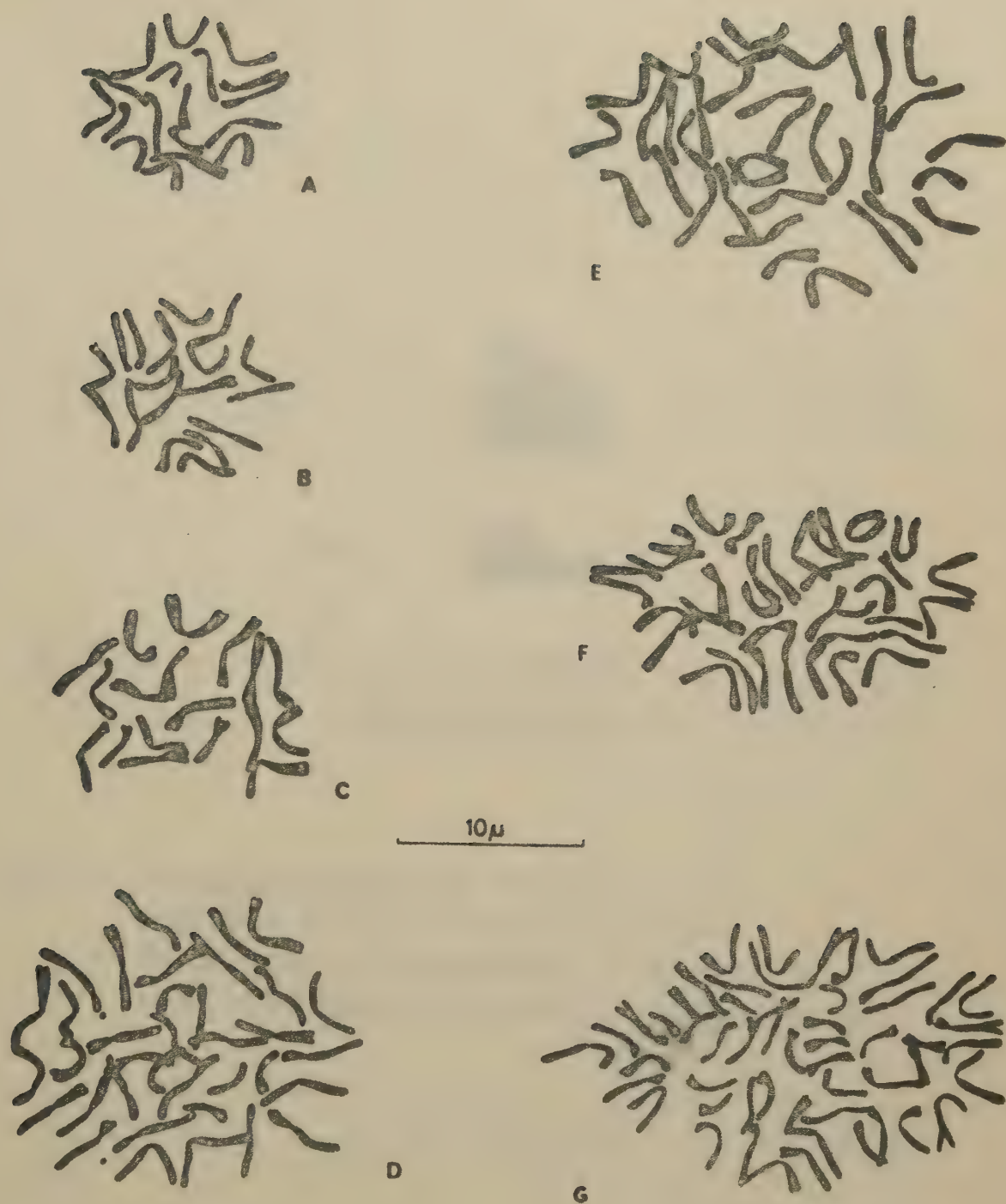


Fig. 12. *Artemisia santonicum*. Root-tip mitoses (microtome-cut preparations). Localities: A: Burgenland, Austria (no. 113-20-1), $2n=18$. -- B: Burgenland, Austria (no. 114-2-1), $2n=18$. -- C: Nitra, Czechoslovakia (no. 123-5-1), $2n=18$. -- D: Cluj, Roumania (no. 157-1-1), $2n=36$. -- E: Cluj, Roumania (no. 157-2-1), $2n=35$. -- F: Hajdu-Bihar, Hungary (no. 163-4-1), $2n=36$. -- G: Thraki, Greece (no. 162-2-1), $2n=54$.

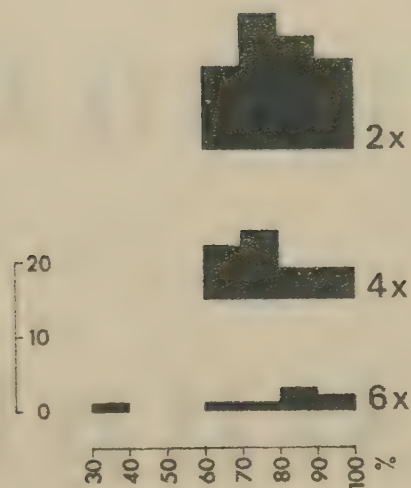


Fig. 13. Artemisia santonicum. Frequencies of stainable pollen grains in diploids, tetraploids and hexaploids. -- On vertical axis number of plants.

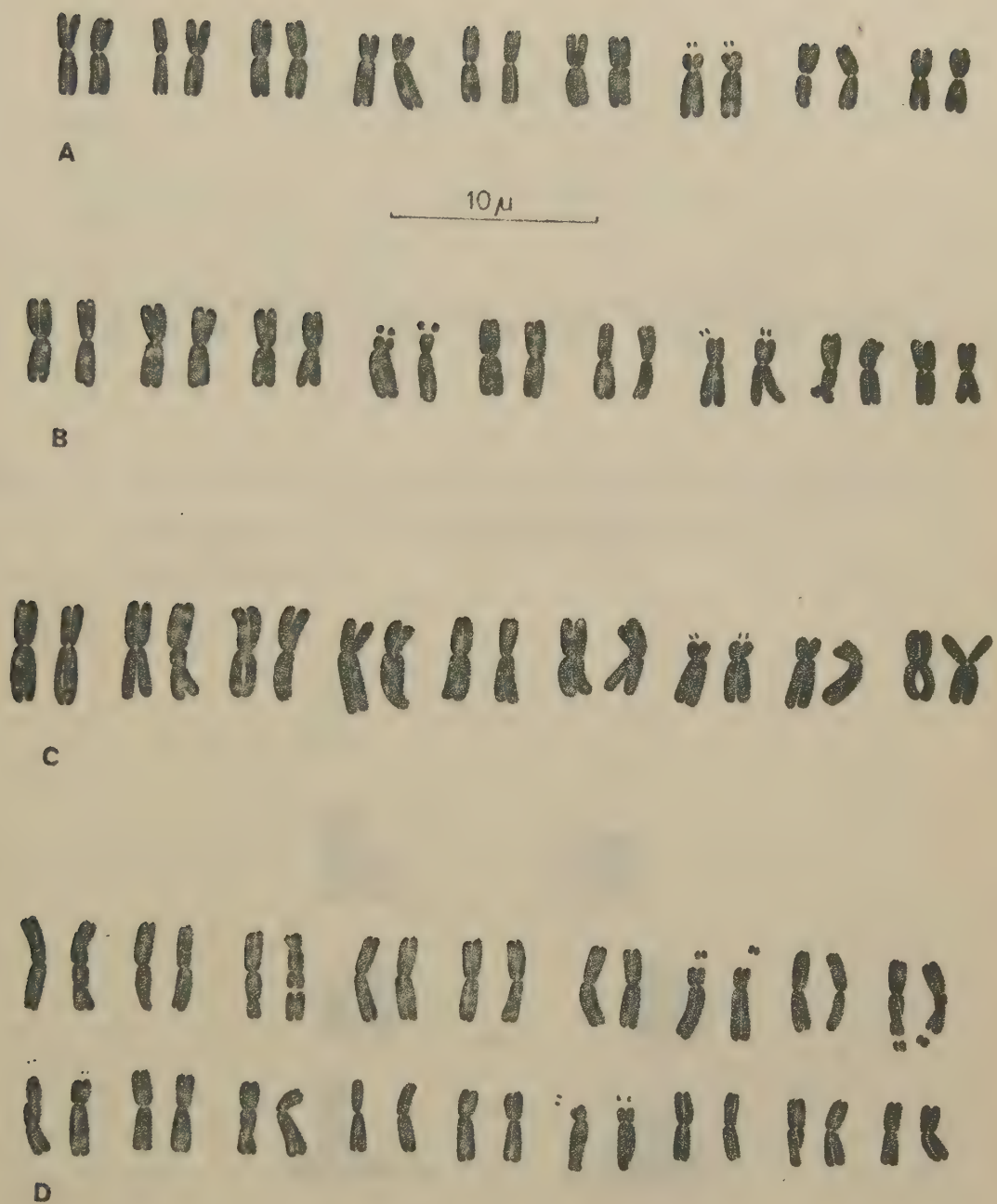


Fig. 14. *Artemisia santonicum*. Karyotype (A--C: diploids, $2n=18$; D: tetraploid, $2n=36$). -- A: no. 114-1-1, B: no. 116-1-1 (both Burgenland, Austria). -- C: no. 123-5-1 (Nitra, Czechoslovakia). -- D: no. 163-4-1 (Hajdu-Bihar, Hungary).

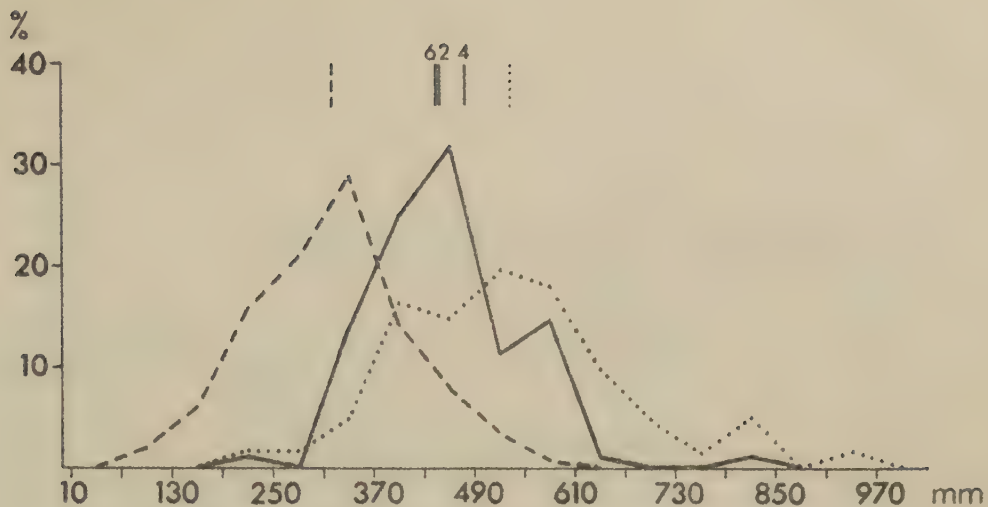


Fig. 15. Variation in shoot length (----- *Artemisia maritima*; *A. vallesiaca*; ——— *A. santonicum*).

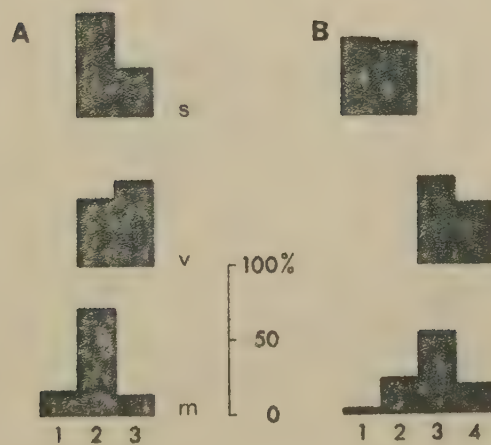


Fig. 16. Variation in degree of suffrutescence (A) and stem pubescence (B) in *Artemisia maritima* (m), *A. vallesiaca* (v) and *A. santonicum* (s). -- Group classifications: A: 1 slightly, 2 moderately, 3 strongly suffrutescent. -- B: 1 almost glabrous, 2 moderately, 3 densely, 4 very densely pubescent.

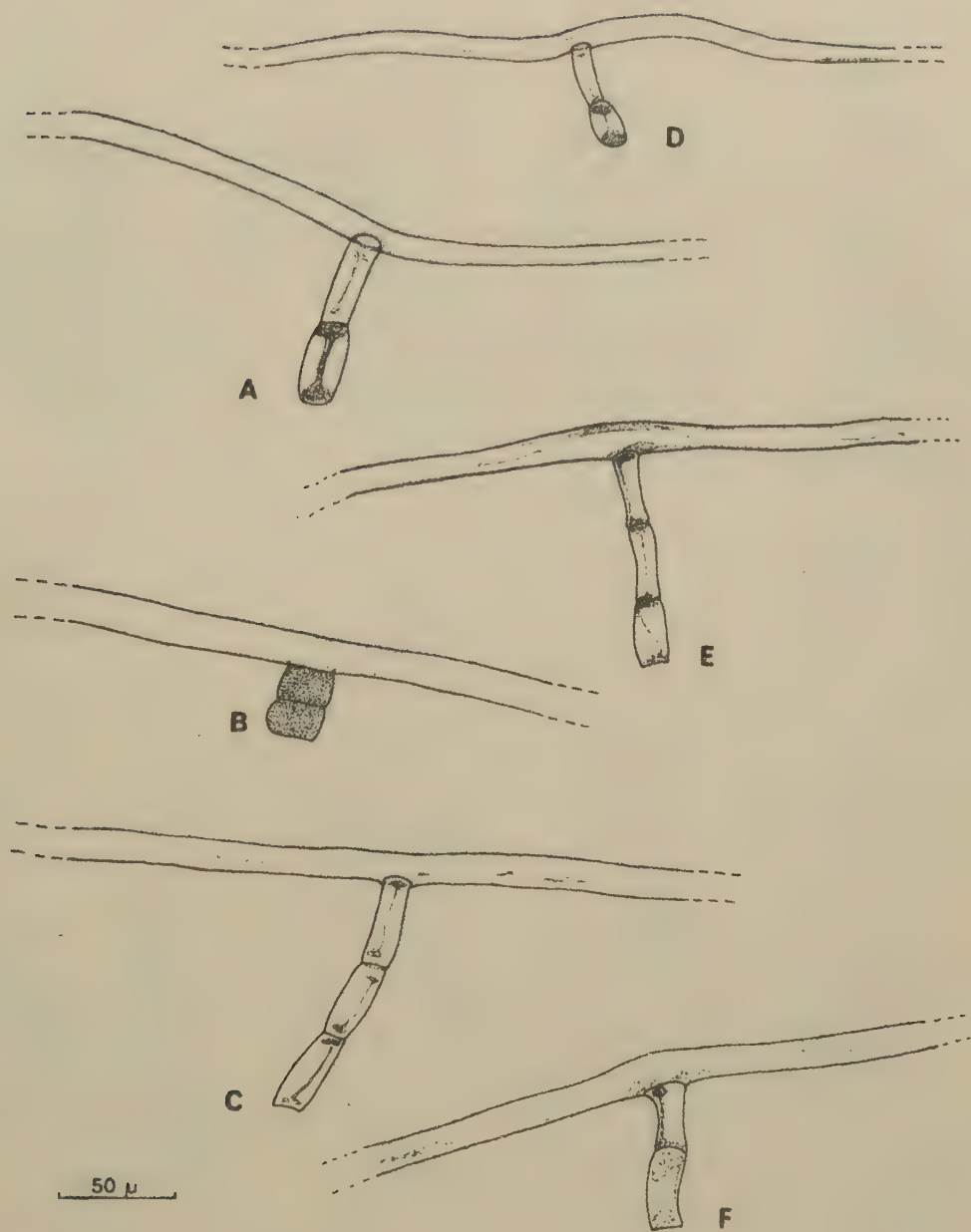


Fig. 17. Hairs. -- A: Artemisia maritima. -- B, C: A. vallesiaca.
D: diploid A. santonicum. -- E: tetraploid A. santonicum.
F: hexaploid A. santonicum.

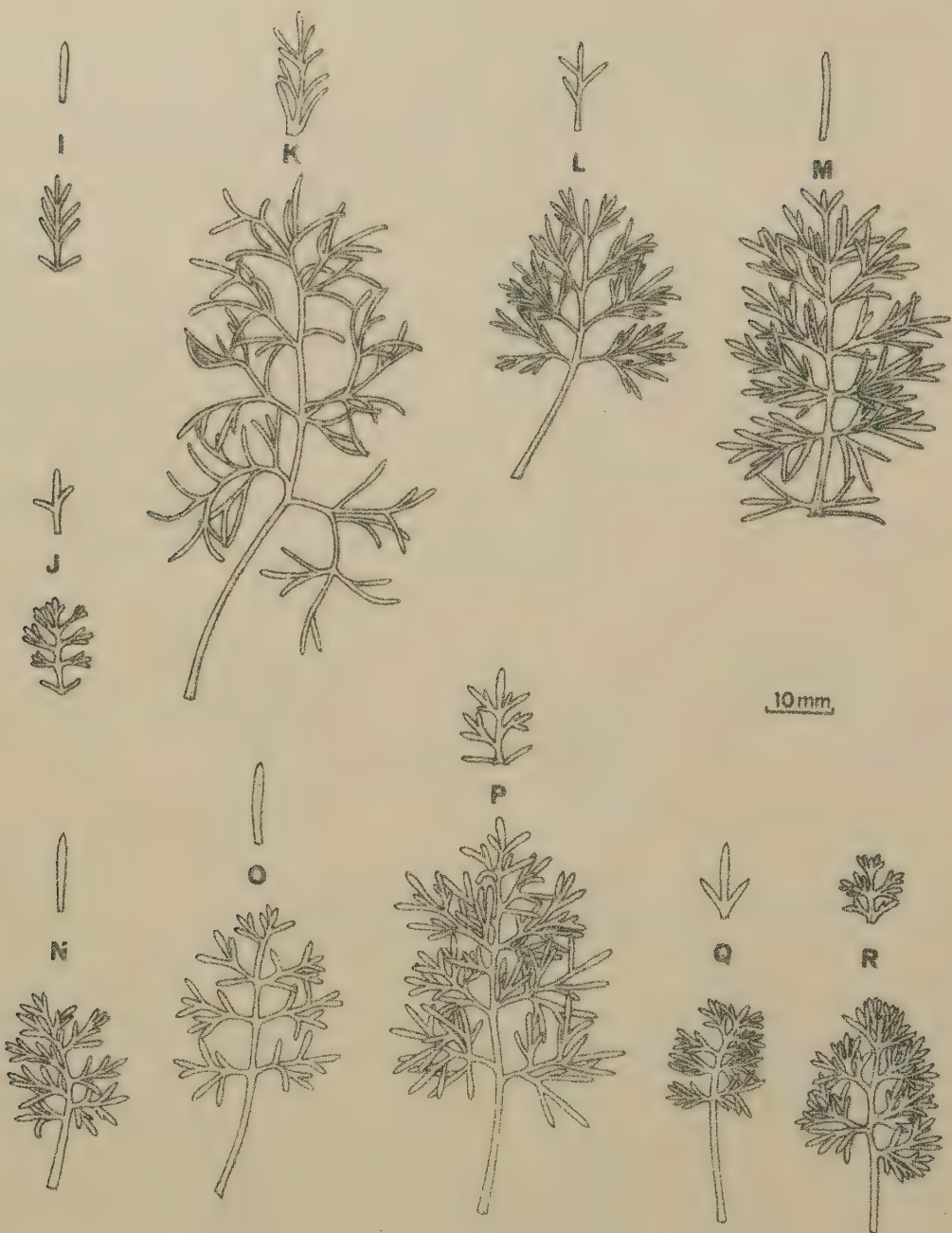


Fig. 18. Leaves of *Artemisia maritima* from lower third of stem and from middle of synflorescence, respectively. -- A--B: Skåne, Sweden. -- C--D: Halland, Sweden. -- E--G: Bohuslän, Sweden. -- H: Gotland, Sweden. -- I--J: Öland, Sweden. -- K: south-eastern Jylland, Denmark. -- L: south-western Jylland, Denmark. -- M: Ostfriesland, Germany. -- N: Somerset, England. -- O: Somme, France. -- P: Vendée, France. -- Q--R: Artern, Germany.



A



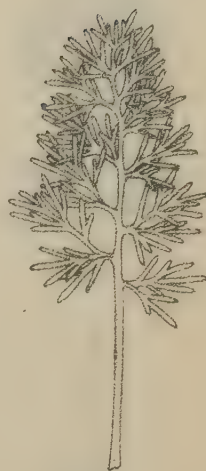
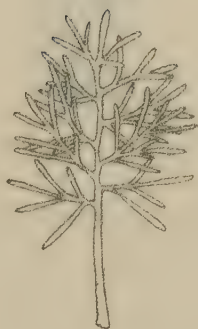
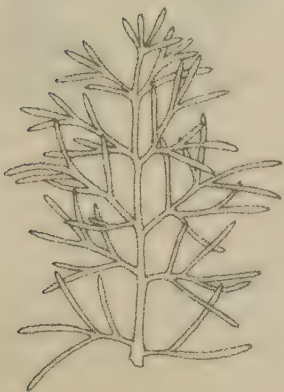
B



C



D



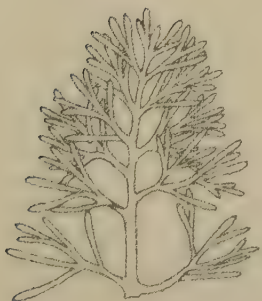
G



E



F



H



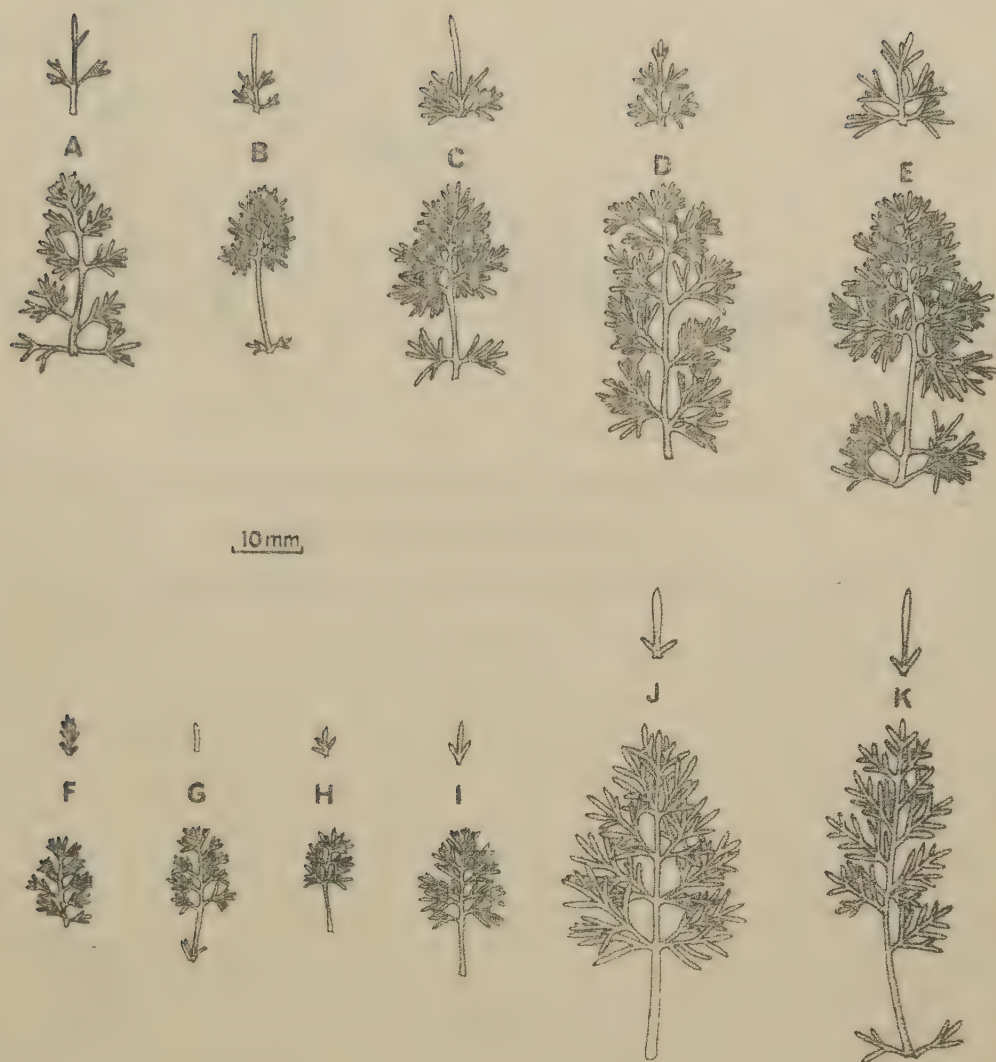


Fig. 19. Leaves of *Artemisia vallesiaca* (A--E) and *A. santonicum* (F--K) from lower third of stem and from middle of synflorescence, respectively. -- A--C: Valais, Switzerland. D--E: Piemonte, Italy. -- F--G: diploid, Burgenland, Austria. -- H: diploid, Nitra, Czechoslovakia. -- I: tetraploid, Hajdu-Bihar, Hungary. -- J: tetraploid, Cluj, Roumania. -- K: hexaploid, Thraki, Greece.

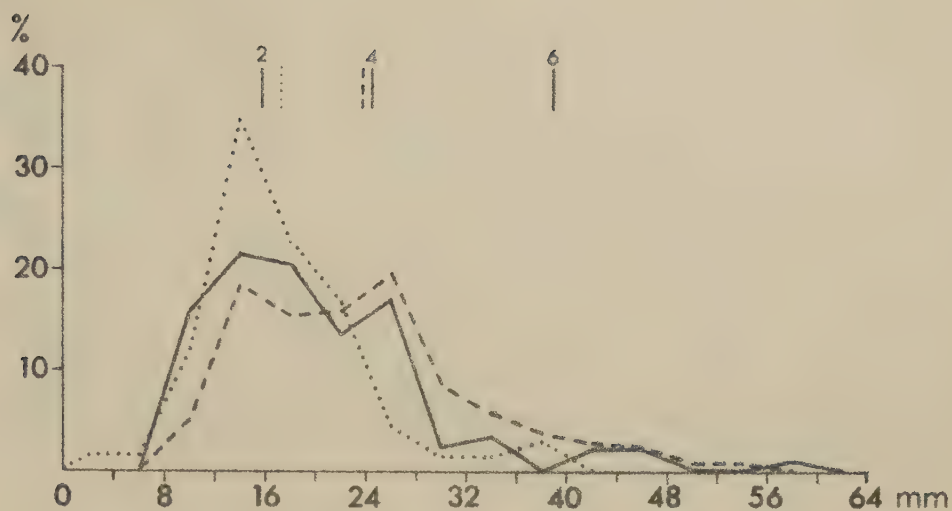


Fig. 20. Variation in length of leaf lamina (----- *Artemisia maritima*; *A. vallesiaca*; — *A. santonicum*).

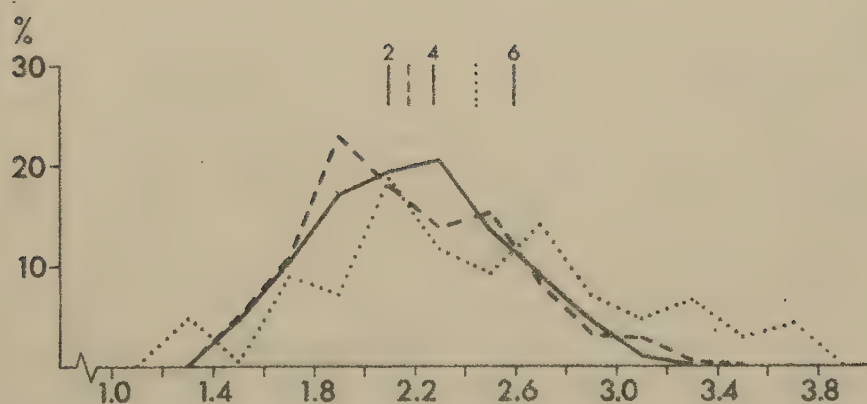


Fig. 21. Variation in leaf lamina length/primary segment length ratio (----- *Artemisia maritima*; *A. vallesiaca*; — *A. santonicum*).

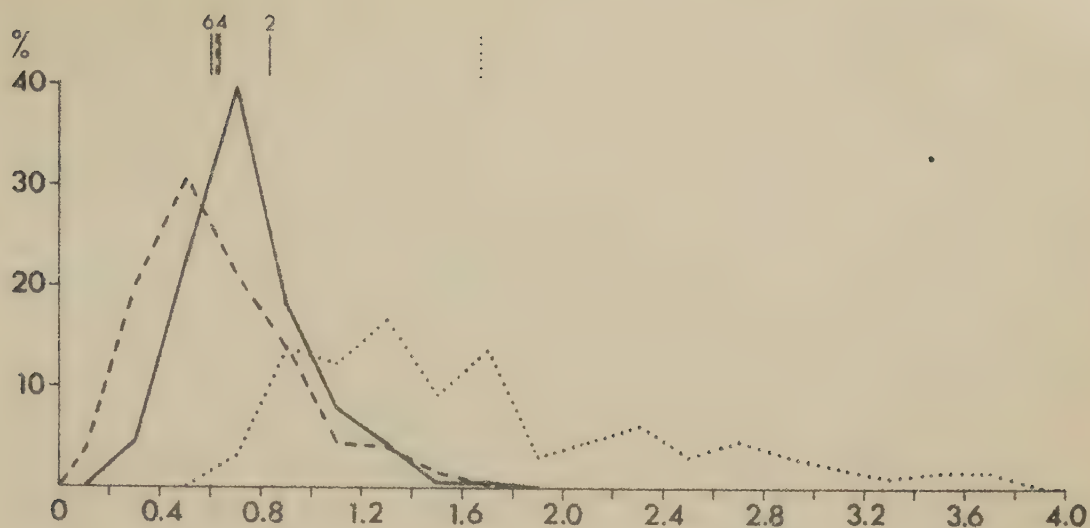


Fig. 22. Variation in degree of leaf segmentation (number of segments on primary segment/length of primary segment ratio).
 ----- Artemisia maritima; A. vallesiaca; ——— A. santonicum.

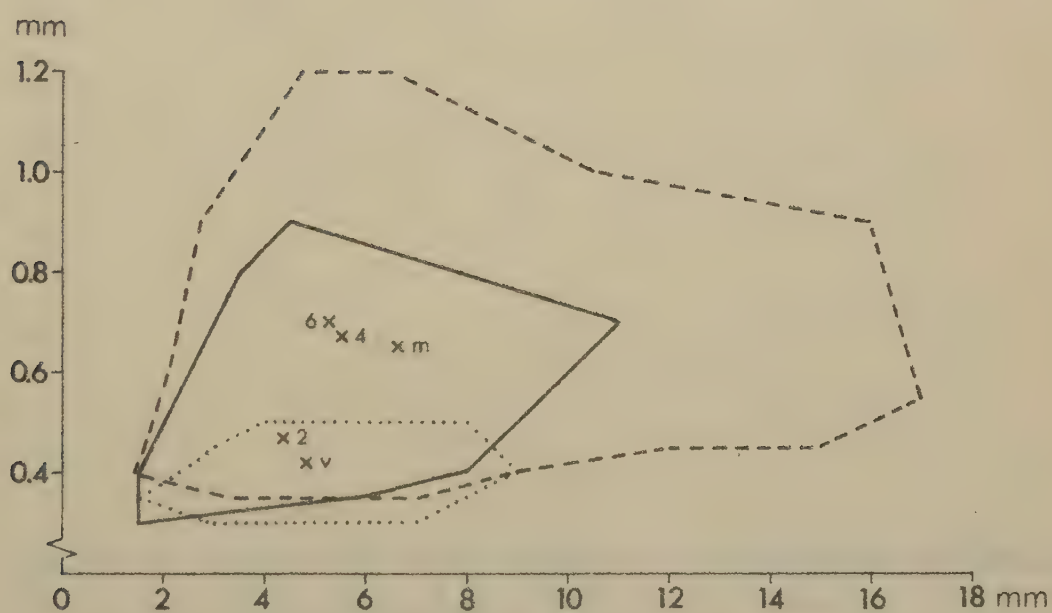


Fig. 23. Secondary leaf segments, length plotted against breadth (----- Artemisia maritima, A. vallesiaca; ——— A. santonicum). Mean values: m = A. maritima; v = A. vallesiaca; 2, 4, 6 = diploid, tetraploid and hexaploid A. santonicum.

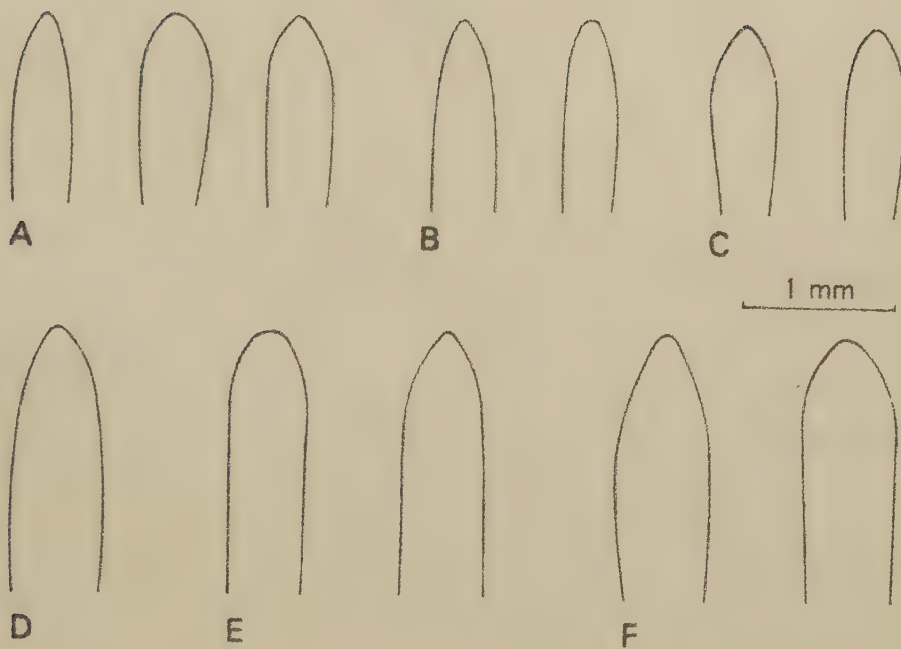


Fig. 24. Apices of secondary leaf segments in Artemisia vallesiaca (A--B) and A. santonicum (C--F). -- A: Valais, Switzerland. -- B: Piemonte, Italy. -- C: diploid, Burgenland, Austria. -- D: tetraploid, Hajdu-Bihar, Hungary. -- E: tetraploid, Cluj, Roumania. -- F: hexaploid, Thraki, Greece.

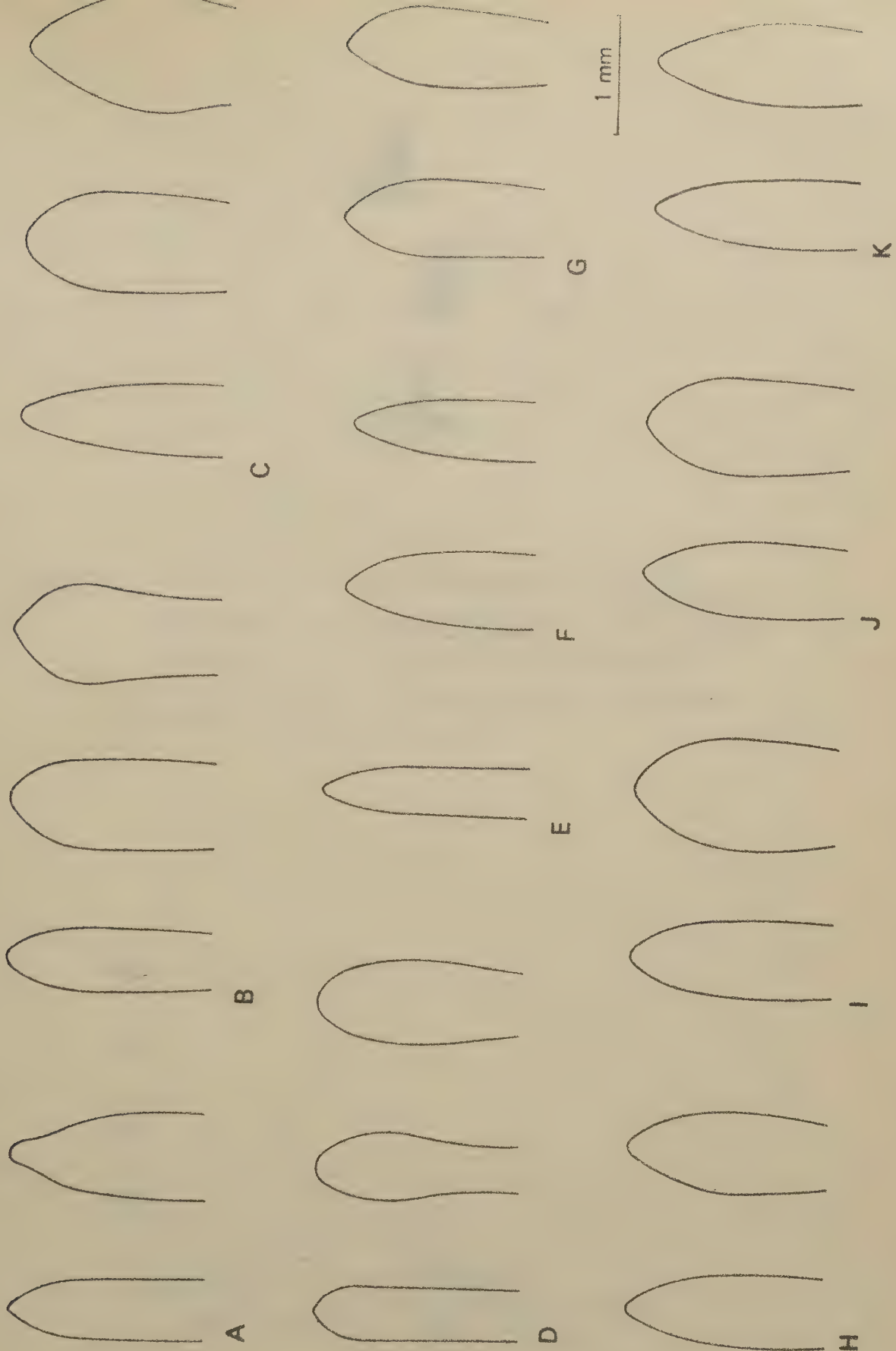


Fig. 25. Apices of secondary leaf segments in Artemisia maritima.
 -- A: Skåne, Sweden. -- B: Halland, Sweden. -- C: Bohuslän, Sweden. -- D: Öland, Sweden. -- E: south-eastern Jylland, Denmark. -- F: south-western Jylland, Denmark. -- G: Nordfriesland, Germany. -- H: Ostfriesland, Germany. -- I: Vendée, France. -- J: Essex, England. -- K: Artern, Germany.

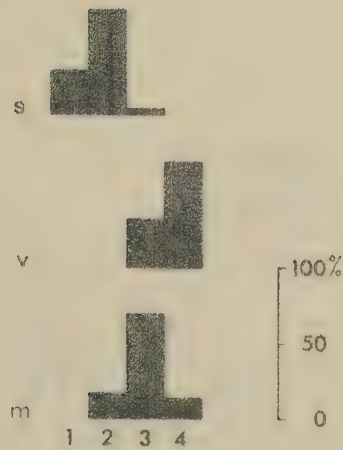


Fig. 26. Variation in leaf pubescence in Artemisia maritima (m), A. vallesiaca (v) and A. santonicum (s). -- Group classifications: 1 almost glabrous, 2 moderately, 3 densely, 4 very densely pubescent.

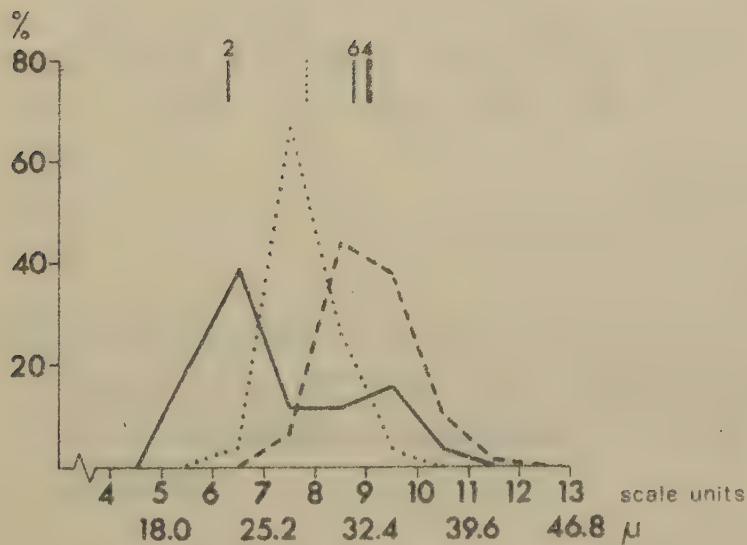


Fig. 27. Variation in stomatal length (----- Artemisia maritima; A. vallesiaca; — A. santonicum).

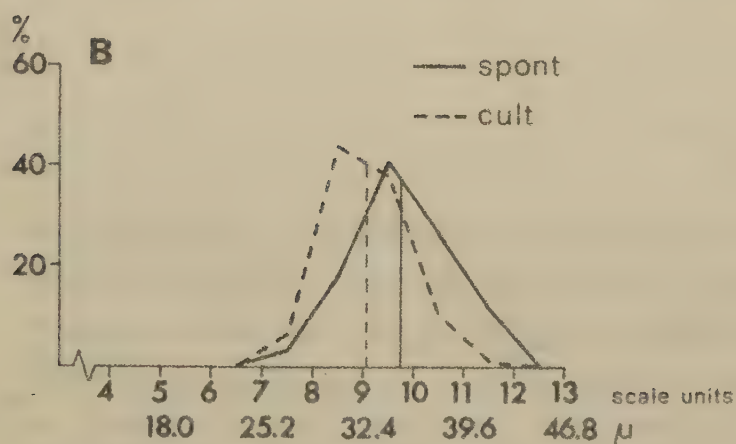
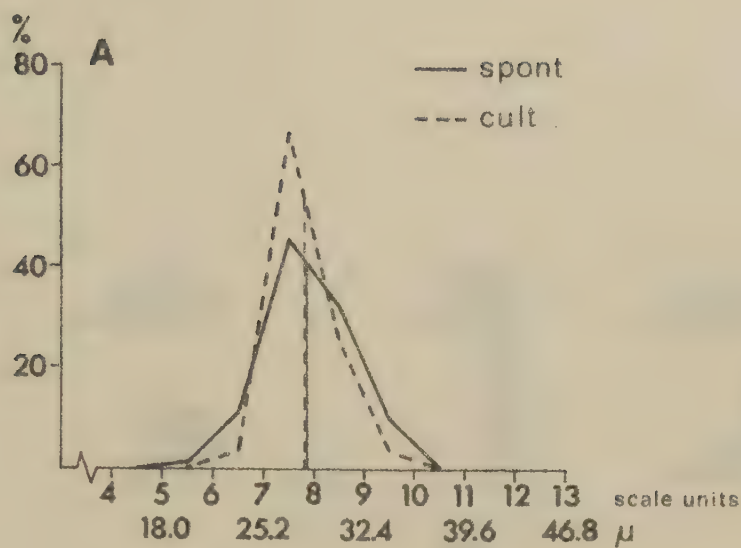


Fig. 28. Stomatal length in nature versus in cultivation under uniform conditions.
 -- A: Artemisia vallesiaca. --- B: A. maritima.

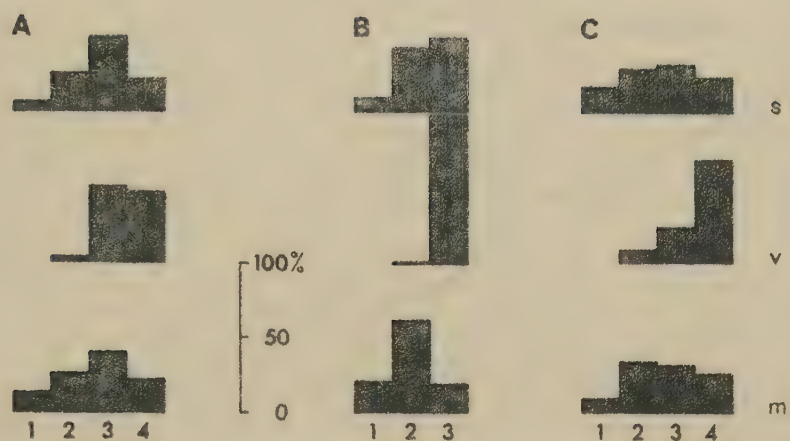


Fig. 29. Variation in synflorescence symmetry (A), branch rigidity (B) and position of capitula on branches (C) in *Artemisia maritima* (m), *A. vallesiaca* (v) and *A. santonicum* (s). -- Group classifications: A: 1 wholly secund, 2 largely secund, 3 slightly secund synflorescence, 4 branches diverging in all directions. B: 1 branches wholly pendent, 2 terminal parts of branches drooping, 3 branches erect. -- C: 1 unilateral position, 2 mixed condition, more like 1, 3 mixed condition, more like 4, 4 multilateral position.

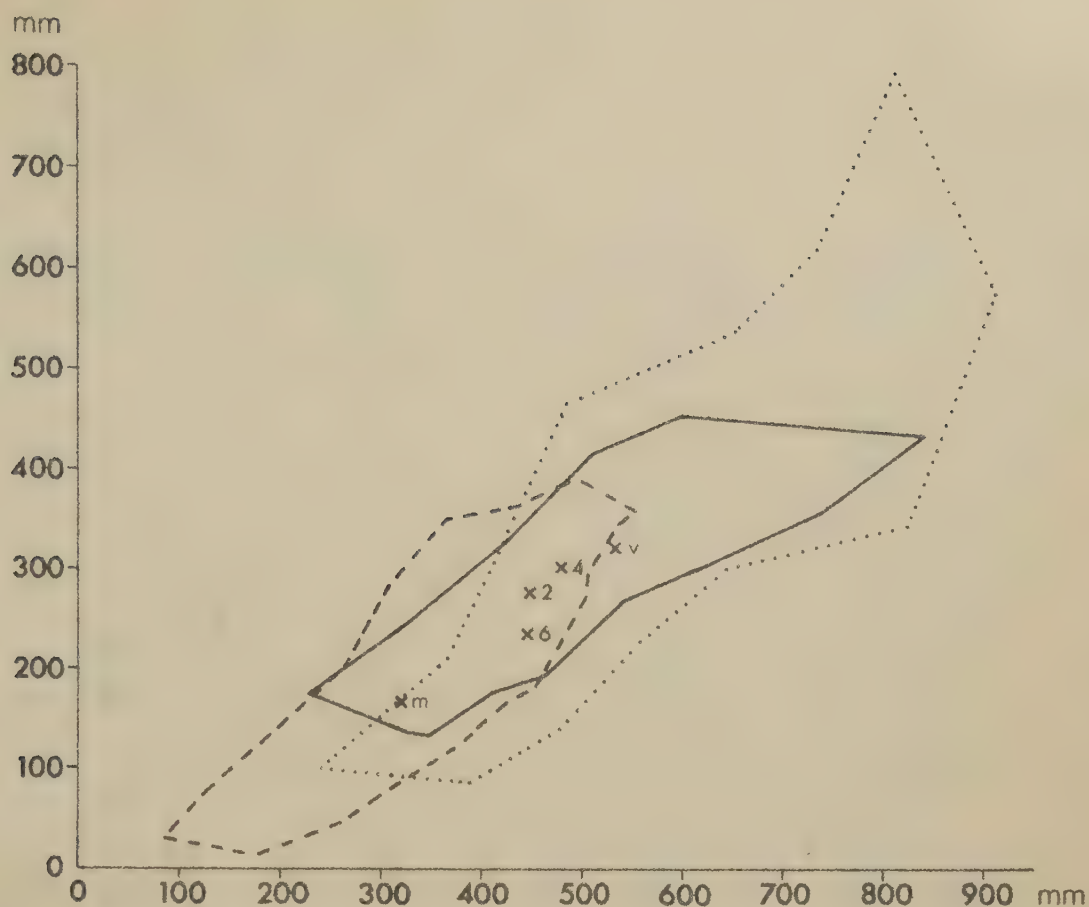


Fig. 30. Synflorescence length plotted against shoot length (----- Artemisia maritima; A. vallesiaca; ——— A. santonicum). Mean values: m = A. maritima; v = A. vallesiaca; 2, 4, 6 = diploid, tetraploid and hexaploid A. santonicum.

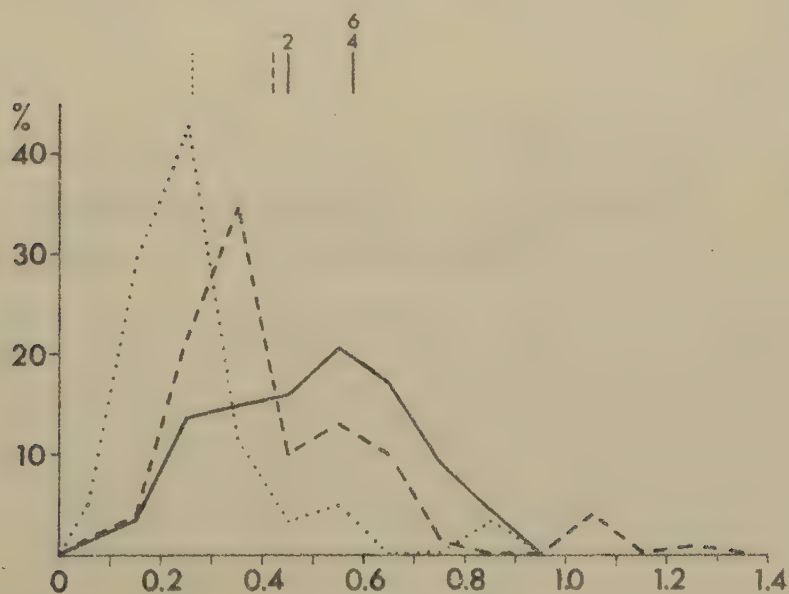


Fig. 31. Variation in density of capitula on branches (number of capitula per mm). ----- Artemisia maritima; A. vallesiaca; ——— A. santonicum.

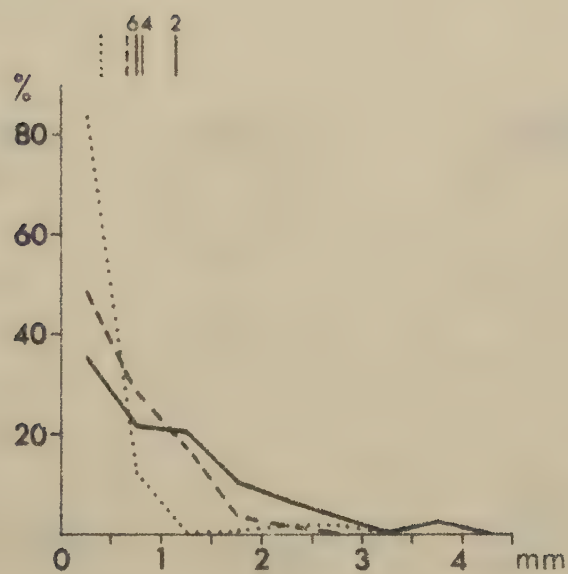


Fig. 32. Variation in peduncle length (----- *Artemisia maritima*; *A. vallesiaca*; — *A. santonicum*).

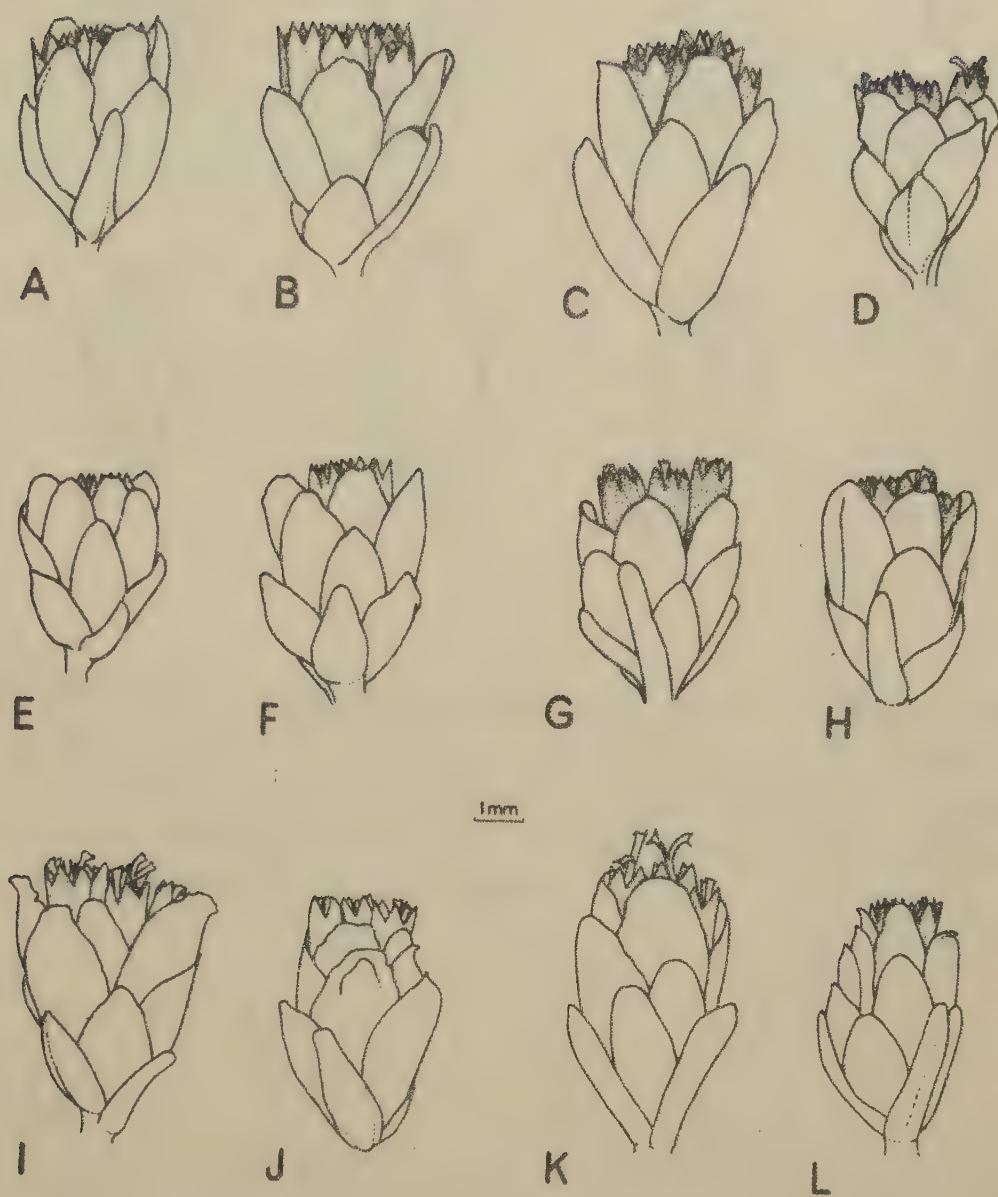


Fig. 33. Capitula in *Artemisia maritima*. -- A: Skåne, Sweden. -- B--C: Bohuslän, Sweden. -- D: Öland, Sweden. -- E: Gotland, Sweden. -- F: south-western Jylland, Denmark. -- G: Ostfriesland, Germany. -- H: Somme, France. -- I: Vendée, France. -- J: Somerset, England. -- K: Norfolk, England. -- L: Artern, Germany.

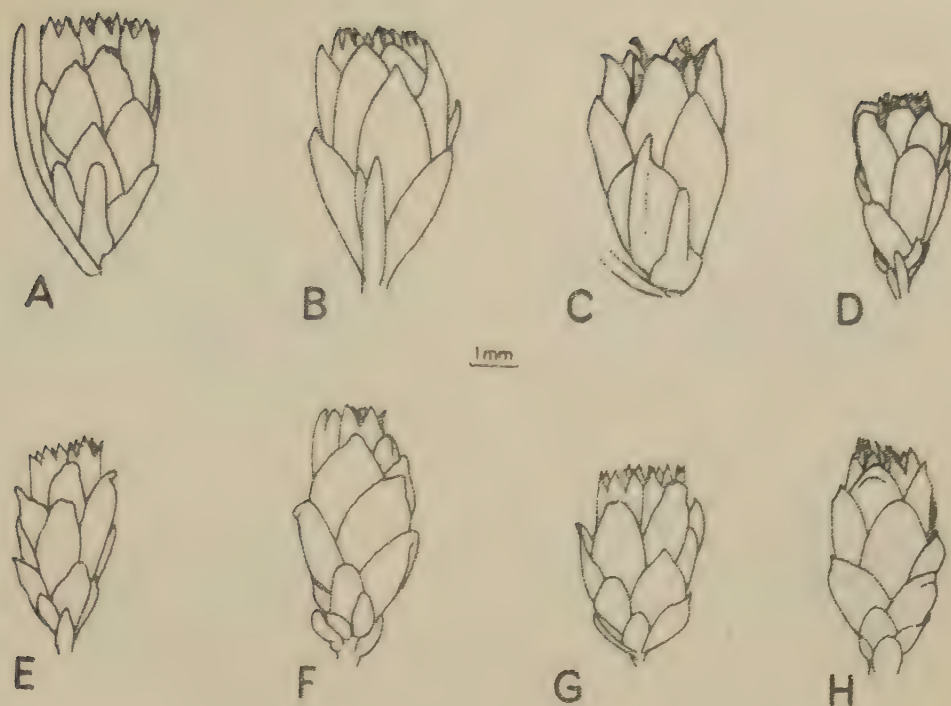


Fig. 34. Capitula in Artemisia vallesiaca (A--C) and A. santonicum (D--H). -- A--B: Valais, Switzerland. -- C: Piemonte, Italy. -- D--E: diploid, Burgenland, Austria. -- F: tetraploid, Hajdu-Bihar, Hungary. -- G: tetraploid, Cluj, Roumania. -- H: hexaploid, Thraki, Greece.

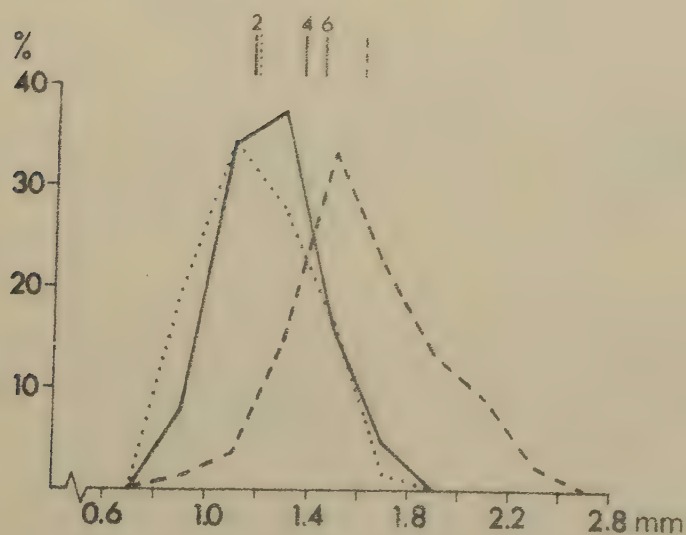


Fig. 35. Variation in breadth of inner phyllaries (----- Artemisia maritima; A. vallesiaca; — A. santonicum).



A



B



C



D



E



F



G



H



I



J



K



L

1 mm

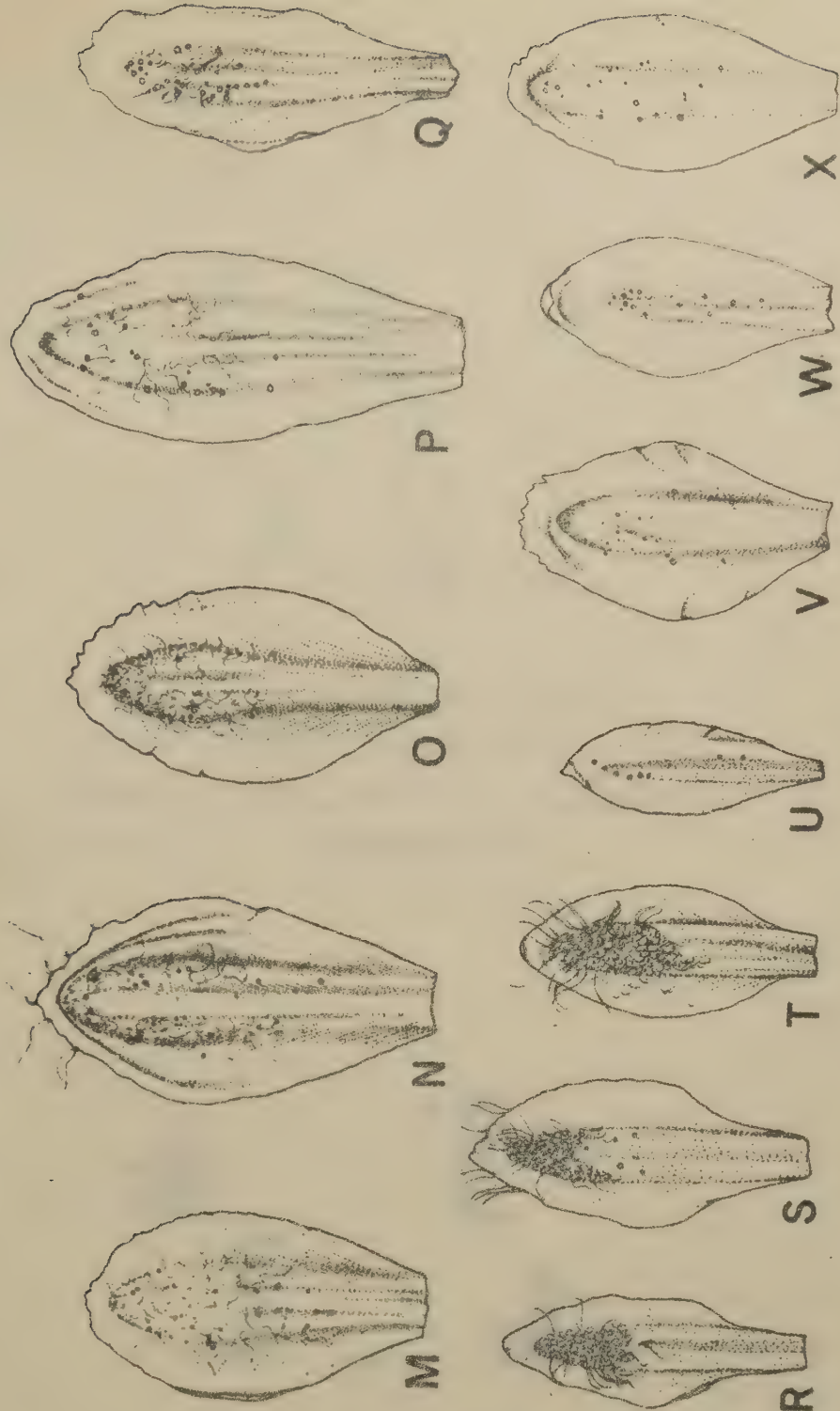


Fig. 36. Inner phyllaries in Artemisia maritima (A--Q), A. vallesiaca (R--T) and A. santonicum (U--X). -- A--B: Skåne, Sweden. -- C--D: Halland, Sweden. -- E--F: Bohuslän, Sweden. -- G--H: Gotland, Sweden. -- I--J: south-western Jylland, Denmark. -- K--L: Ostfriesland, Germany. -- M: Somme, France. -- N: Vendée, France. -- O: Somerset, England. -- P: Essex, England. -- Q: Artern, Germany. -- R--S: Valais, Switzerland. -- T: Piemonte, Italy. -- U: diploid, Burgenland, Austria. -- V: tetraploid, Hajdu-Bihar, Hungary. -- W: tetraploid, Cluj, Roumania. -- X: hexaploid, Thraki, Greece.

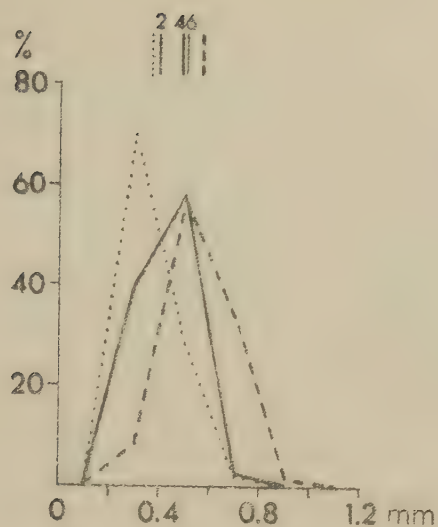


Fig. 37. Variation in breadth of scarious margins of inner phyllaries (----- Artemisia maritima; A. vallesiaca; — A. santonicum).

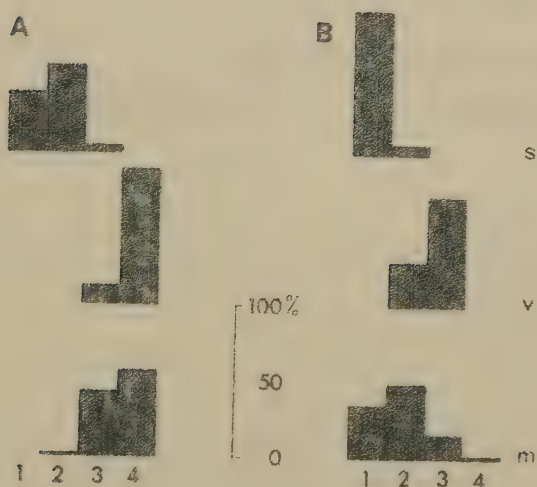


Fig. 38. Variation in phyllary pubescence in Artemisia maritima (m), A. vallesiaca (v) and A. santonicum (s). -- A: outer phyllaries. -- B: inner phyllaries. -- Group classifications: 1 almost glabrous, 2 moderately, 3 densely, 4 very densely pubescent.

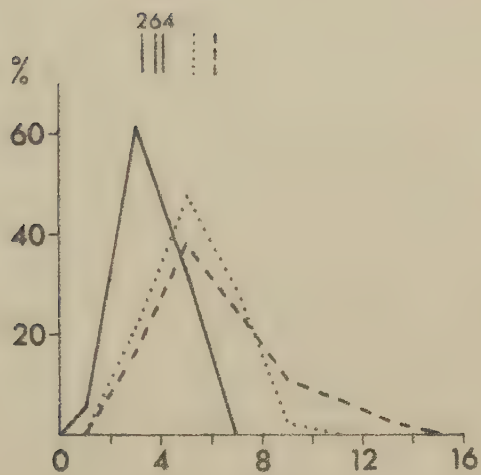


Fig. 39. Variation in number of florets per capitulum (----- Artemisia maritima; A. vallesiaca; ——— A. santonicum).

Fig. 40. Sections of capitula. -- A--D: Artemisia maritima (A: Skåne, Sweden; B: Öland, Sweden; C: Bohuslän, Sweden; D: Nordfriesland, Germany). -- E--F: A. vallesiaca (Valais, Switzerland). -- G--H: A. santonicum (G: diploid, Austria; H: tetraploid, Roumania). -- A--D X25, E, G--H X60, F X160.

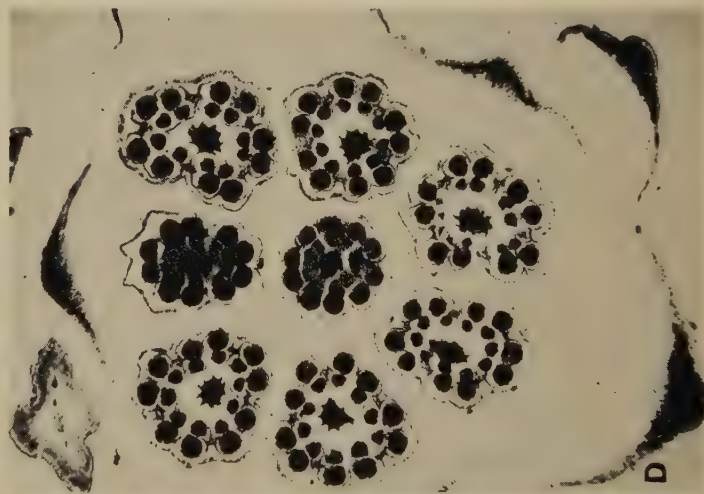
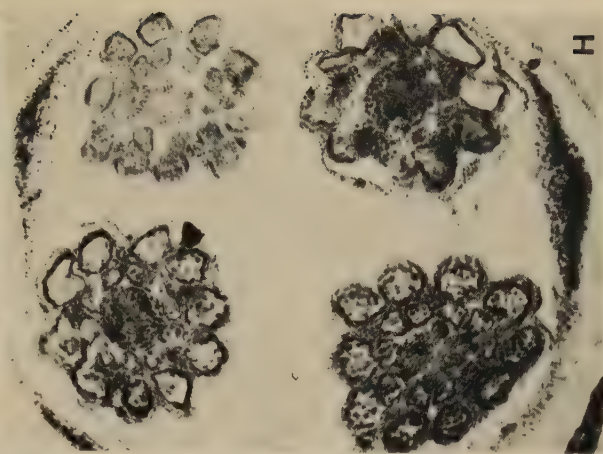
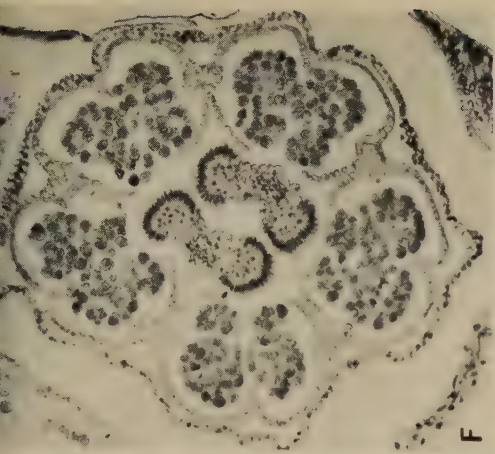
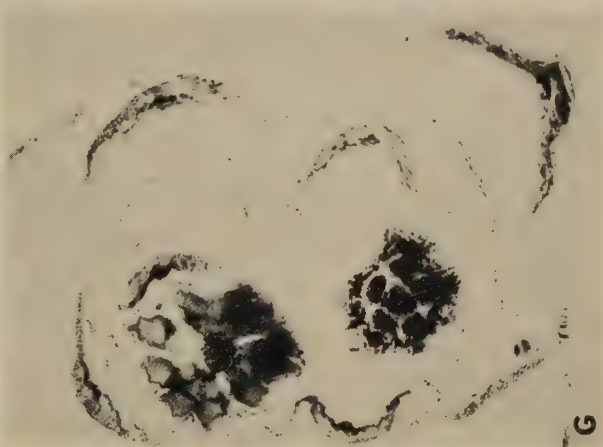
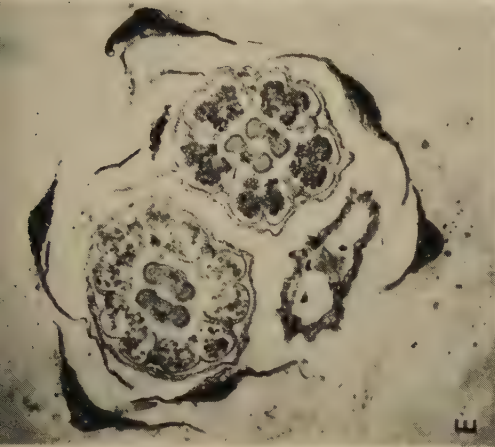
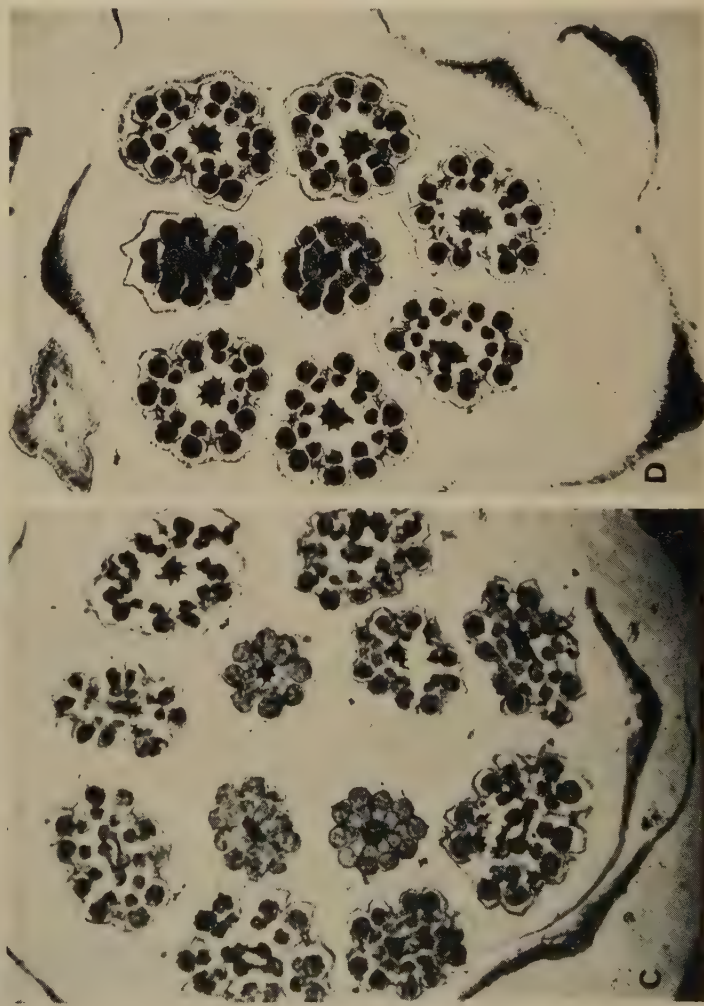
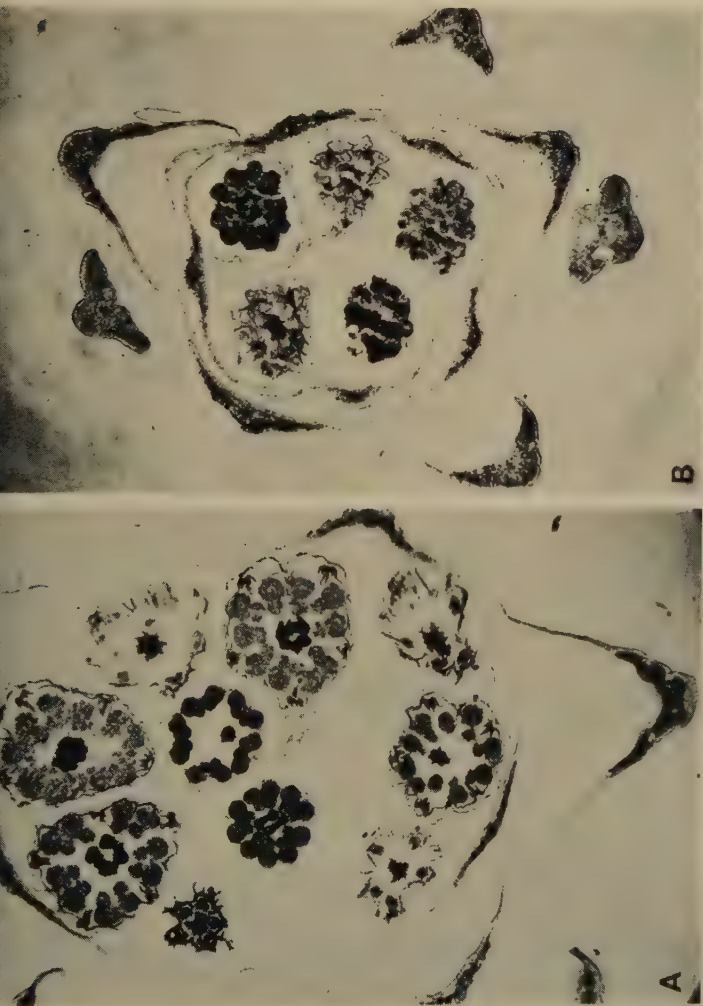


Fig. 40.

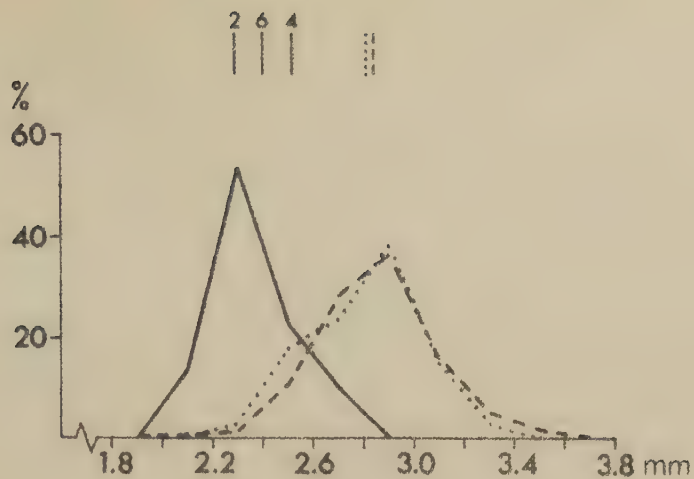


Fig. 41. Variation in corolla length (----- Artemisia maritima; A. vallesiaca; ——— A. santonicum).

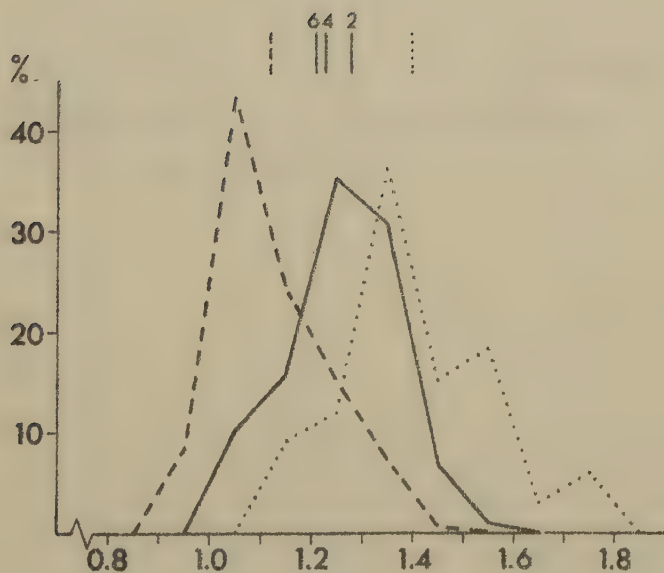


Fig. 42. Variation in length/breadth ratio of corolla lobe (----- Artemisia maritima; A. vallesiaca; ——— A. santonicum).

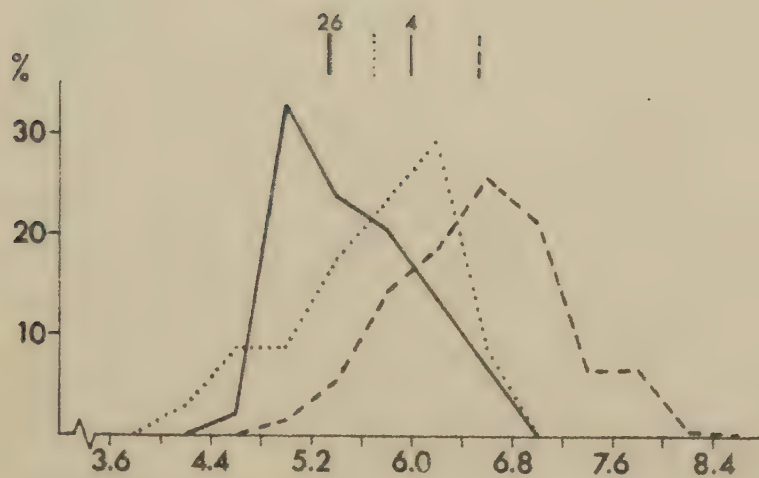


Fig. 43. Variation in corolla length/corolla lobe length ratio (----- Artemisia maritima; A. vallesiaca; ——— A. santonicum).



A



B

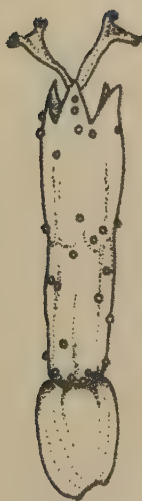


C



D

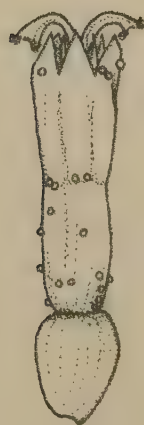
1mm



E



F



G



H

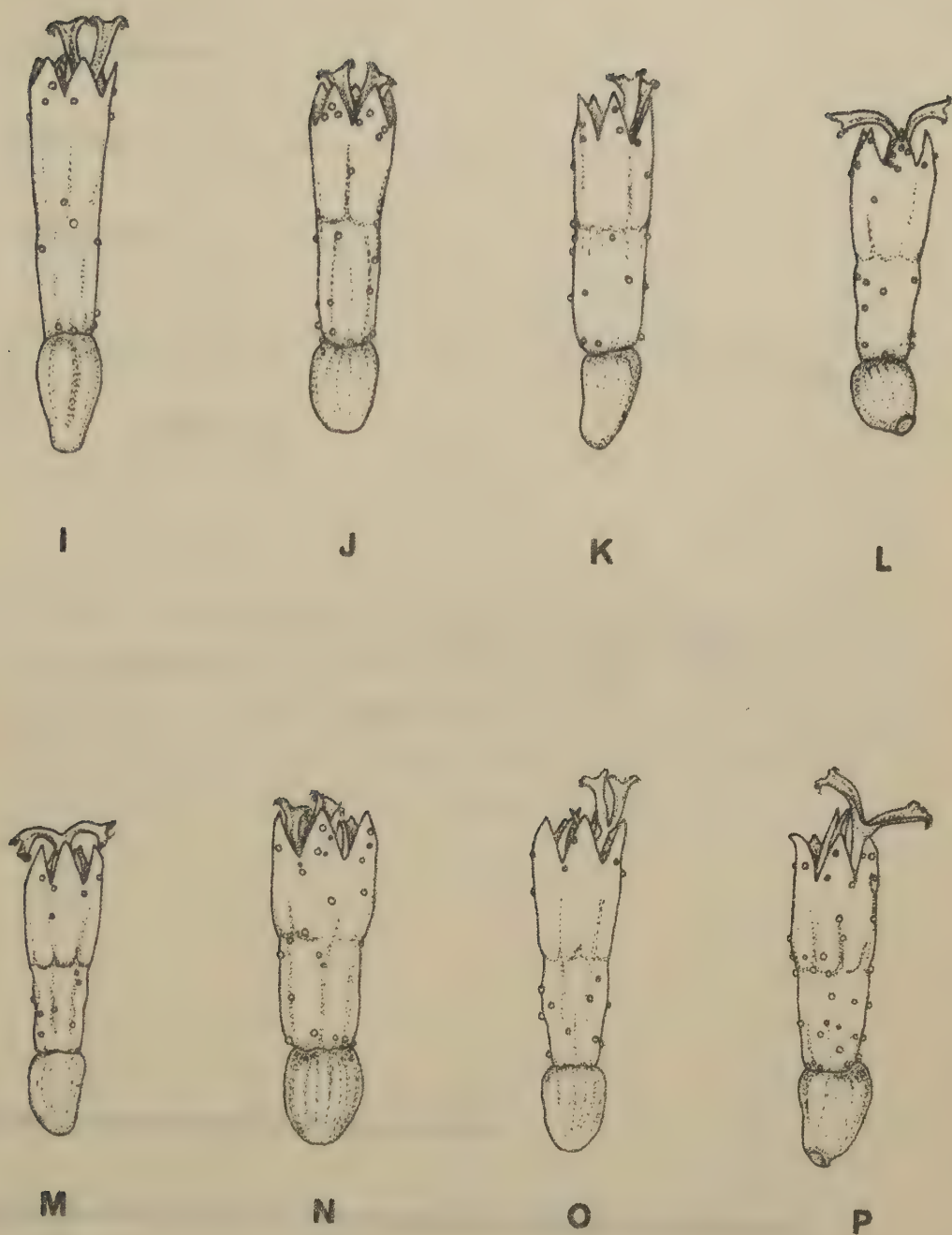


Fig. 44. Florets in Artemisia maritima (A--J), A. vallesiaca (K--L) and A. santonicum (M--P). -- A: Skåne, Sweden. -- B: Halland, Sweden. -- C: Bohuslän, Sweden. -- D: Öland, Sweden. -- E: south-western Jylland, Denmark. -- F: Nordfriesland, Germany. -- G: Ostfriesland, Germany. -- H: Vendée, France. -- I: Norfolk, England. -- J: Artern, Germany. -- K: Valais, Switzerland. -- L: Piemonte, Italy. -- M: diploid, Burgenland, Austria. -- N: tetraploid, Hajdu-Bihar, Hungary. -- O: tetraploid, Cluj, Roumania. -- P: hexaploid, Thraki, Greece.

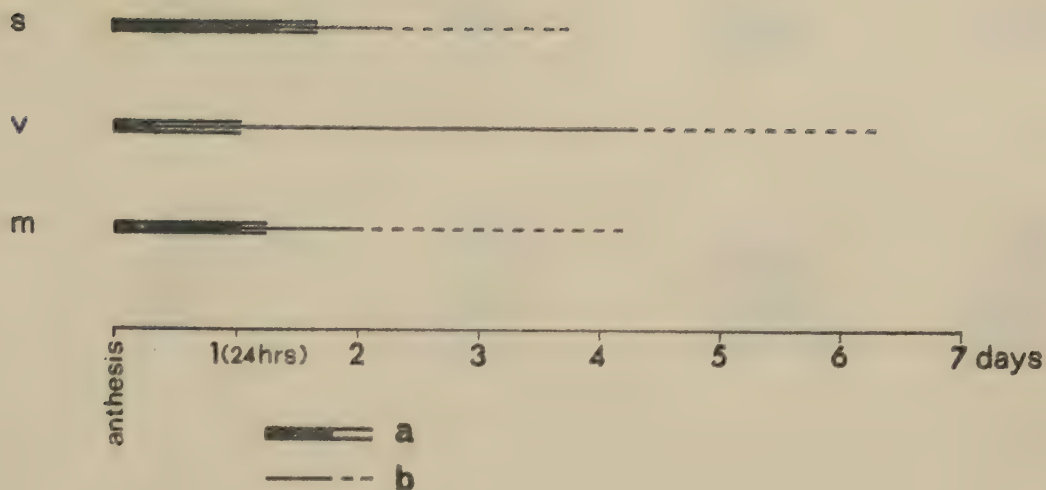


Fig. 45. Flower periodicity in *Artemisia maritima* (m), *A. vallesiaca* (v) and *A. santonicum* (diploid, s). Min. and max. time from anthesis to recurving of stigmatic branches (a) and from recurving to withering of stigmatic branches (b).

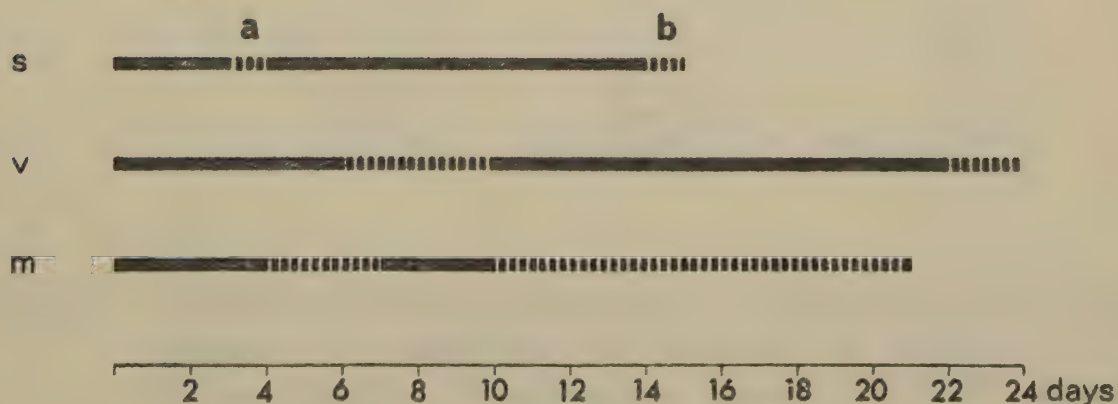


Fig. 46. Duration of flowering per head (a) and per plant (b) in *Artemisia maritima* (m), *A. vallesiaca* (v) and *A. santonicum* (s).

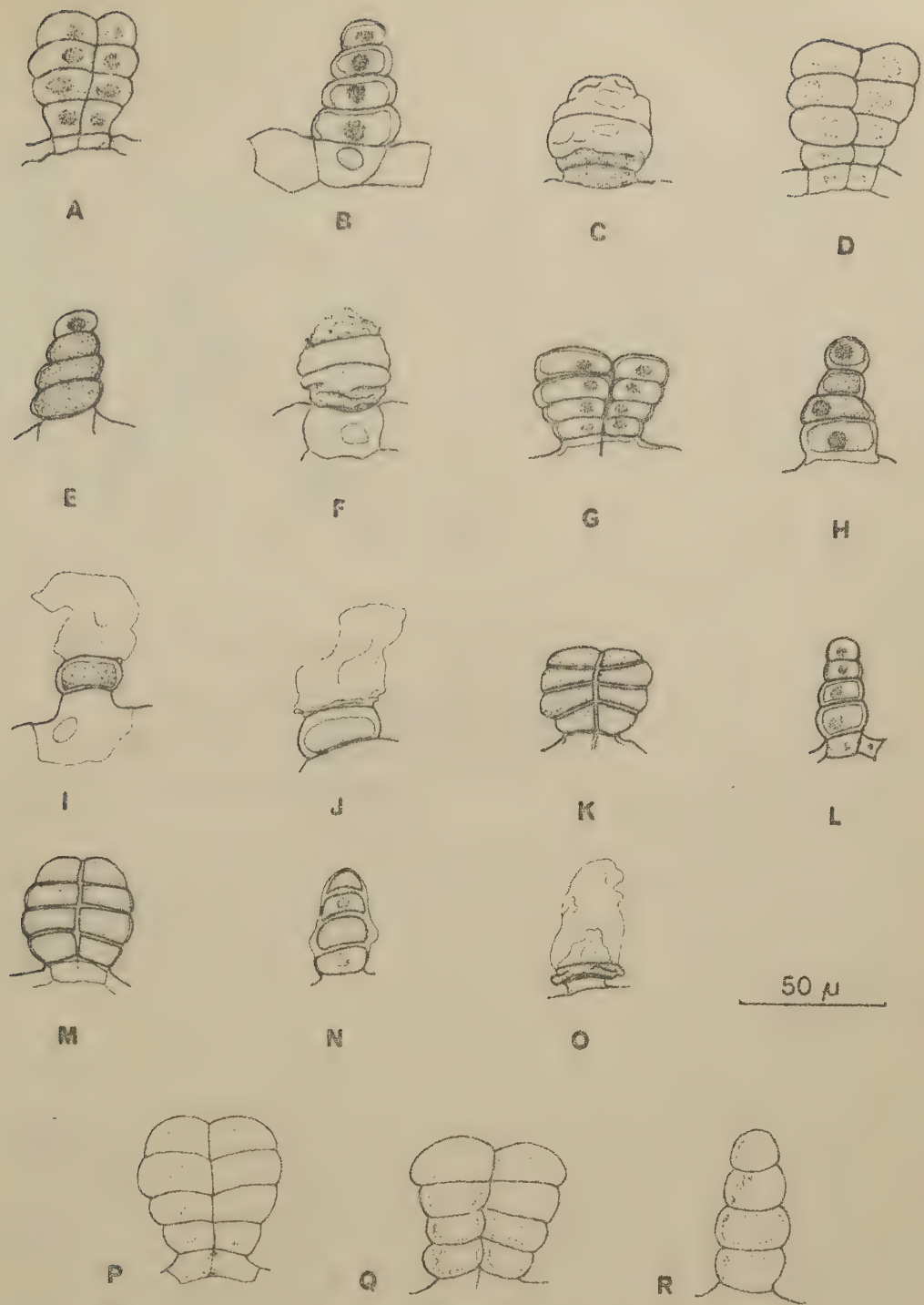


Fig. 47. Glands in Artemisia maritima, A. vallesiaca and A. santonicum. -- A. maritima: A: frontal, B: lateral view of floret gland, C: degenerate floret gland; D: frontal, E: lateral view of phyllary gland, F: degenerate phyllary gland. -- A. vallesiaca: G: frontal, H: lateral view of floret gland, I: degenerate floret gland; J: degenerate phyllary gland. -- A. santonicum (diploid): K: frontal L: lateral view of floret gland; M: frontal, N: lateral view of phyllary gland, O: degenerate phyllary gland. -- A. santonicum (tetraploid): P: frontal view of phyllary gland. -- A. santonicum (hexaploid): Q: frontal, R: lateral view of floret gland.

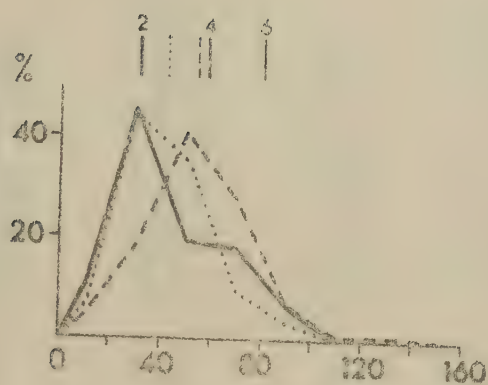


Fig. 48. Variation in number of glands per floret (----- *Artemisia maritima*; *A. vallesiaca*; ——— *A. santonicum*).

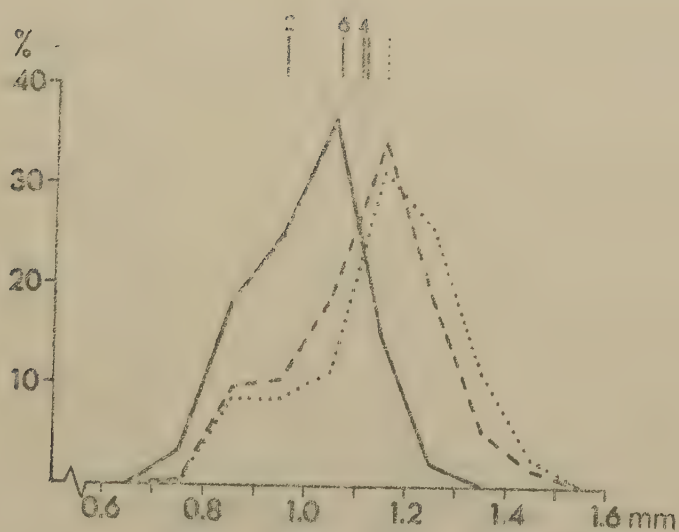


Fig. 49. Variation in theca length (----- *Artemisia maritima*; *A. vallesiaca*; ——— *A. santonicum*).

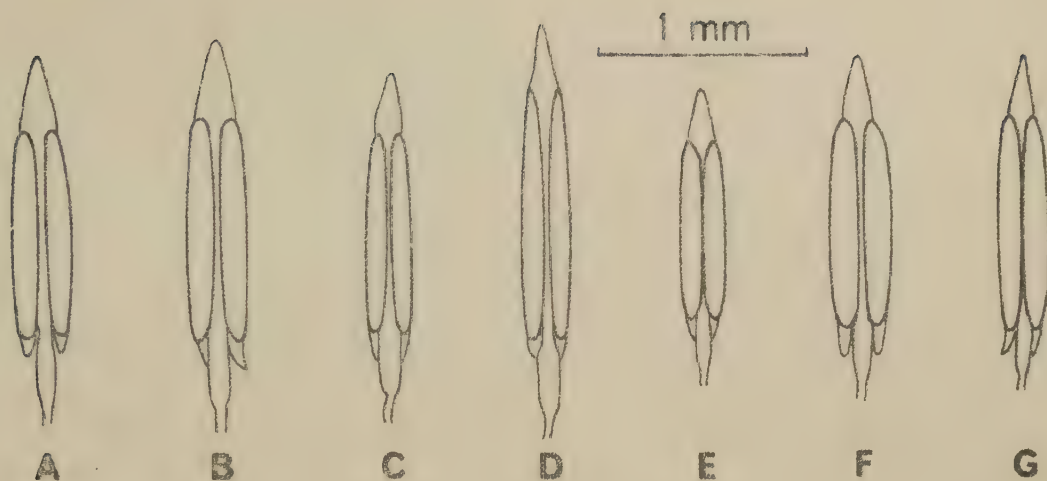


Fig. 50. Stamens in Artemisia maritima (A--C), A. vallesiaca (D) and A. santonicum (E--G). -- A: Skåne, Sweden. -- B: Halland, Sweden. --- C: Öland, Sweden. -- D: Valais, Switzerland. -- E: diploid, Burgenland, Austria. -- F: tetraploid, Hajdu-Bihar, Hungary. -- G: hexaploid, Thraki, Greece.

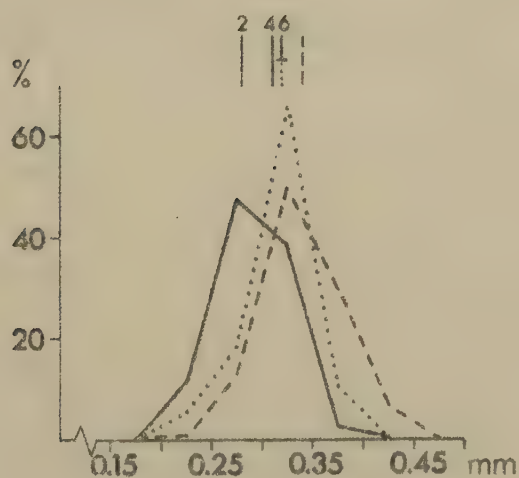


Fig. 51. Variation in length of connective appendage (----- Artemisia maritima; A. vallesiaca; ——— A. santonicum).

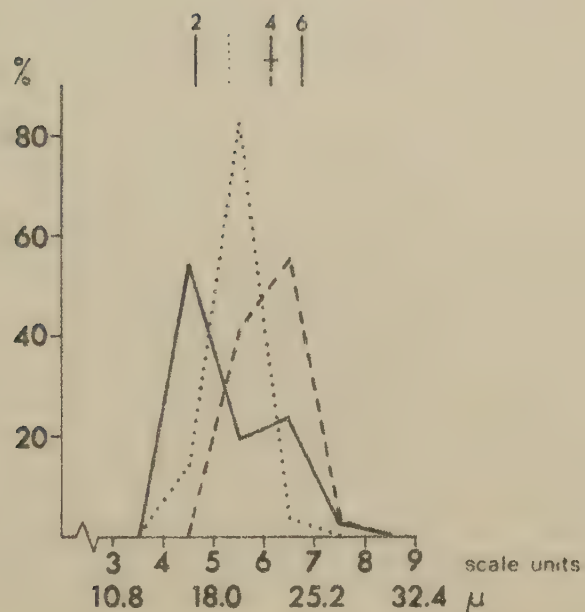


Fig. 52. Variation in pollen diameter (----- Artemisia maritima; A. vallesiaca; ——— A. santonicum).

Fig. 53. Pollen grains (in polar view) in Artemisia maritima.
-- A: normal, B: giant pollen grain, plant no. 14-1-1
(Skåne, Sweden). -- C: normal, D: giant pollen grain,
plant no. 27-5-2 (northern Sjaelland, Denmark). -- E:
Fehmarn, Germany. -- F: Nordfriesland, Germany. -- X1750.

Fig. 54. Pollen grains (in polar view) in Artemisia vallesiaca
(A--B) and A. santonicum (C--E). -- Valais, Switzer-
land. -- B: Piemonte, Italy. -- C: diploid, Burgenland,
Austria. -- D: tetraploid, Cluj, Roumania. -- E: hexa-
ploid, Thraki, Greece.

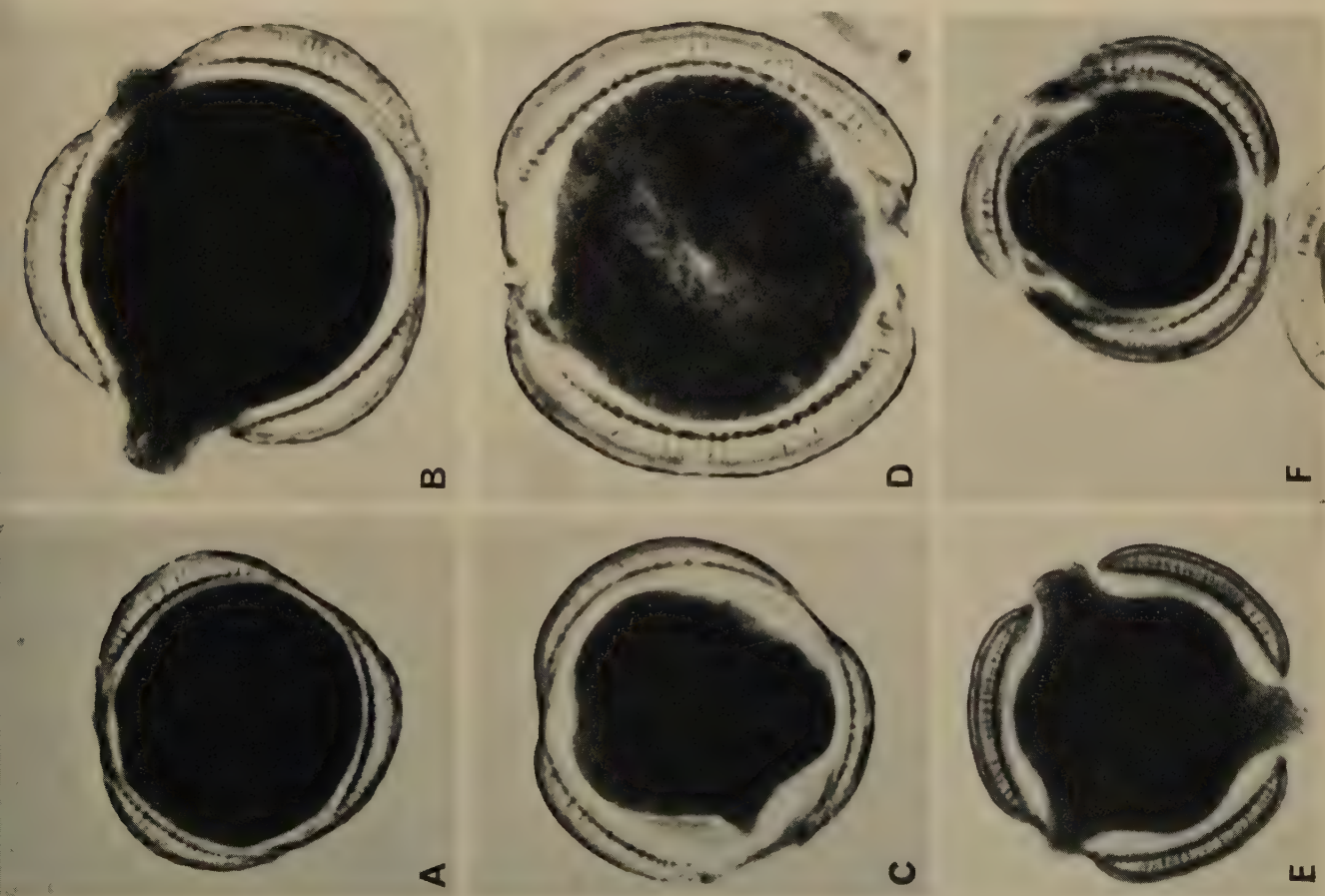


Fig. 53.

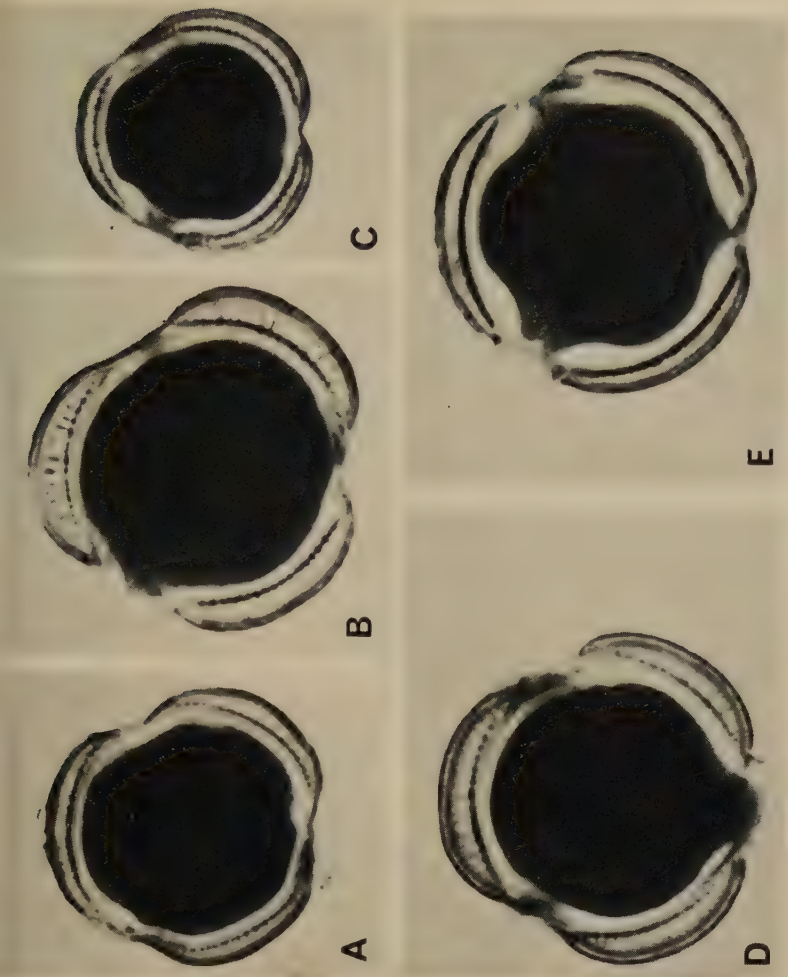


Fig. 54.

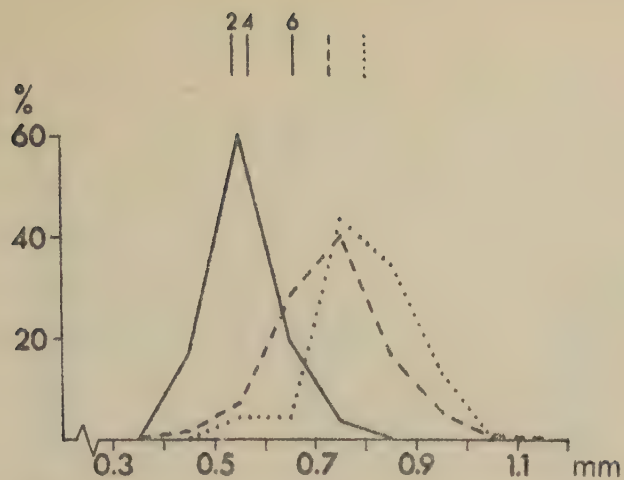


Fig. 55. Variation in length of style branch (----- *Artemisia maritima*; *A. vallesiaca*; ——— *A. santonicum*).

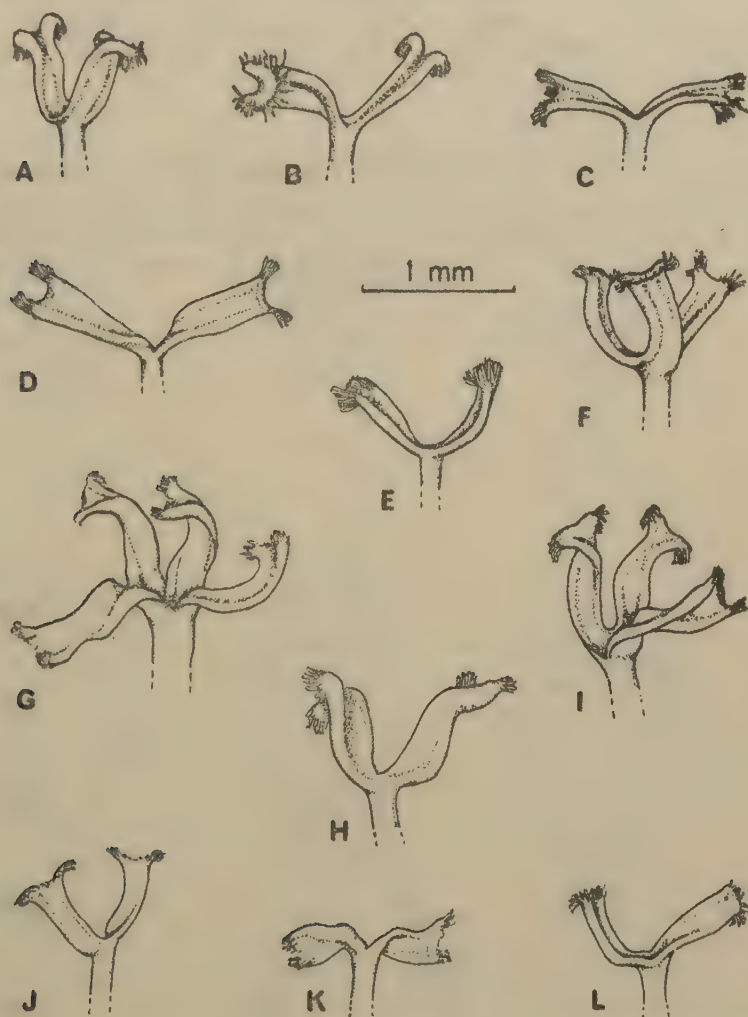


Fig. 56. Style branches in *Artemisia maritima* (A--G), *A. vallesiaca* (H--I) and *A. santonicum* (J--L). -- A: Skåne, Sweden. -- B: Bohuslän, Sweden. -- C: Gotland, Sweden. -- D: south-western Jylland, Denmark. -- E: Nordfriesland, Germany. -- F: northern Sjaelland, Denmark. -- G: eastern Sjaelland, Denmark. -- H--I: Valais, Switzerland. J: tetraploid, Cluj, Roumania. -- K: diploid, Burgenland, Austria. -- L: hexaploid, Thraki, Greece.

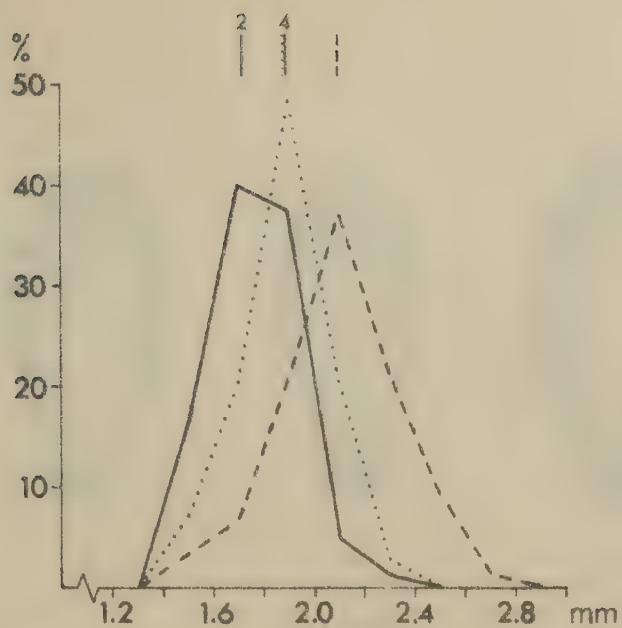


Fig. 57. Variation in achene length (----- Artemisia maritima; A. vallesiaca; ——— A. santonicum).

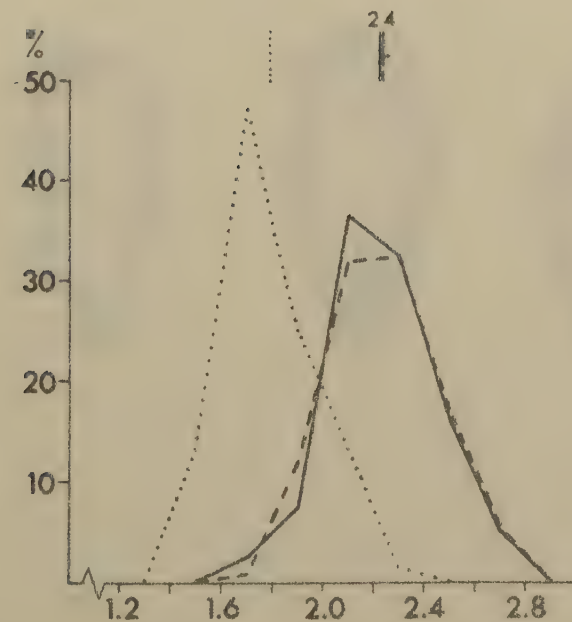


Fig. 58. Variation in length/breadth ratio of achenes (----- Artemisia maritima; A. vallesiaca; ——— A. santonicum).



Fig. 59. Achenes in Artemisia maritima (A--J) and A. vallesiaca (K--L). -- A--B: Skåne, Sweden. -- C--D: Bohuslän, Sweden. -- E--F: Gotland, Sweden. -- G: Ostfriesland, Sweden. -- H: Vendée, France. -- I: Somerset, England. -- J: Artern, Germany. -- K--L: Valais, Switzerland.

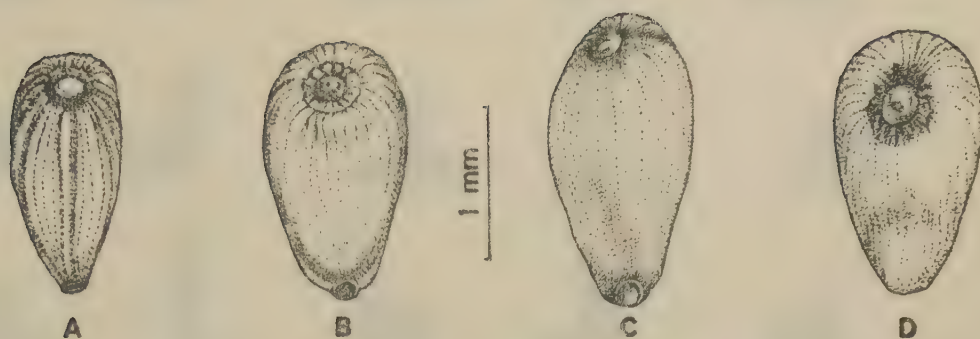


Fig. 60. Achenes in Artemisia santonicum. -- A--B: diploid, Burgenland, Austria. -- C: tetraploid, Hajdu-Bihar, Hungary. -- D: tetraploid, Cluj, Roumania.

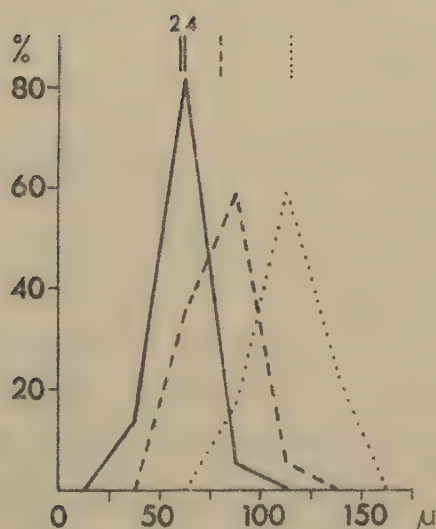


Fig. 61. Variation in breadth of achene ridges (----- Artemisia maritima; A. vallesiaca; ——— A. santonicum).

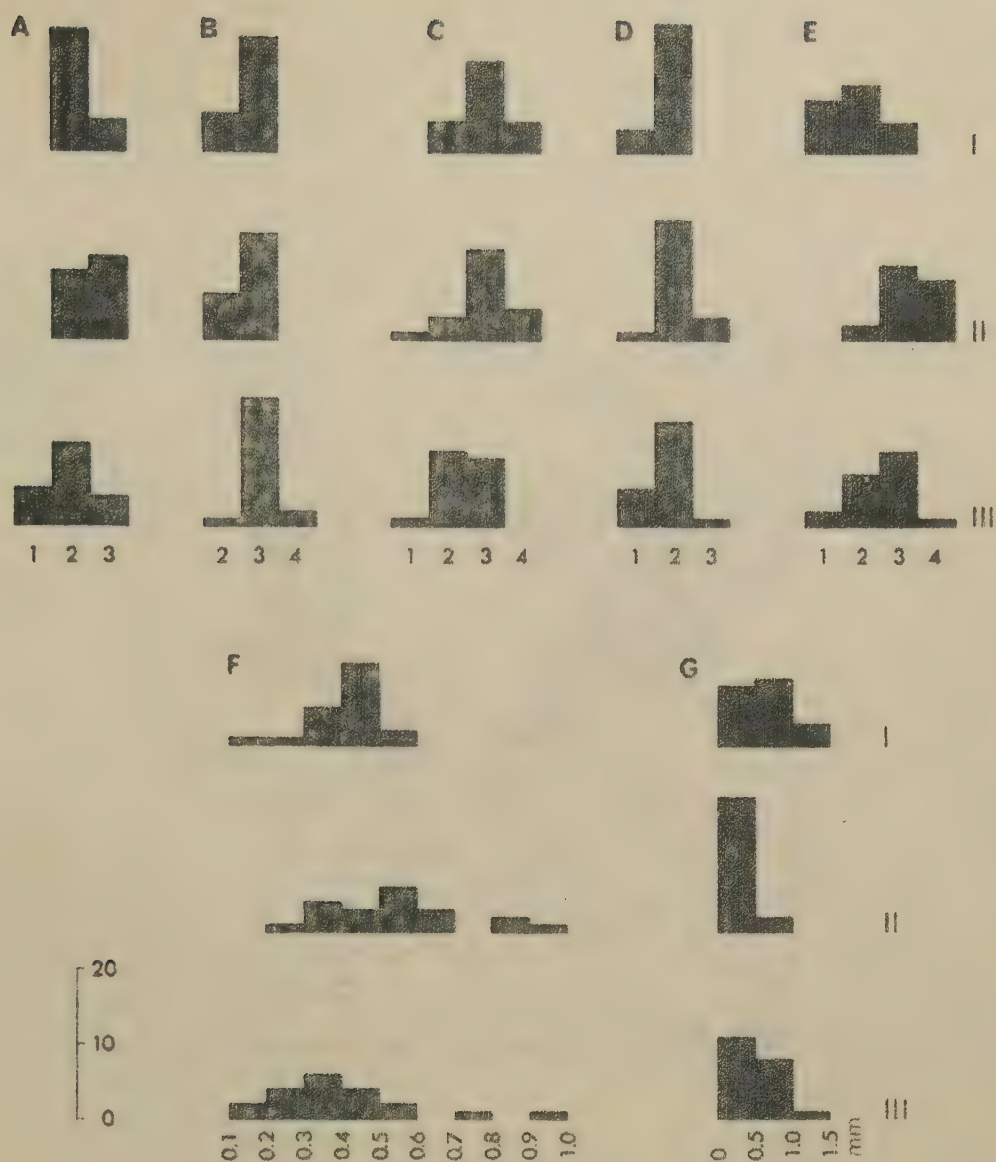


Fig. 62. *Artemisia maritima*. Variation at population level. The populations: I Skanör, Skåne, Sweden; II Roskilde, Sjælland, Denmark; III Esbjerg, Jylland, Denmark. -- A: degree of suffrutescence. -- B: degree of stem pubescence. -- C: synflorescence symmetry. -- D: degree of branch rigidity. -- E: position of capitula on branches. -- F: number of capitula per mm on branches. -- G: peduncle length. -- Group classifications: A: 1 slightly, 2 moderately, 3 strongly suffrutescent. -- B: 1 almost glabrous, 2 moderately, 3 densely, 4 very densely pubescent. -- C: 1 wholly secund, 2 largely secund, 3 slightly secund synflorescence, 4 branches diverging in all directions. -- D: 1 branches wholly pendent, 2 terminal parts of branches drooping, 3 branches erect. -- E: 1 unilateral position, 2 mixed condition, more like 1, 3 mixed condition, more like 4, 4 multilateral position.

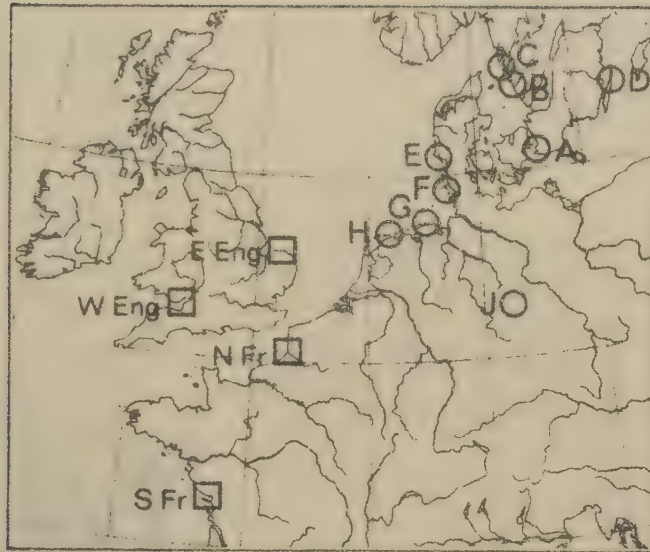


Fig. 63. Localities of the grand populations subjected to morphological analysis.

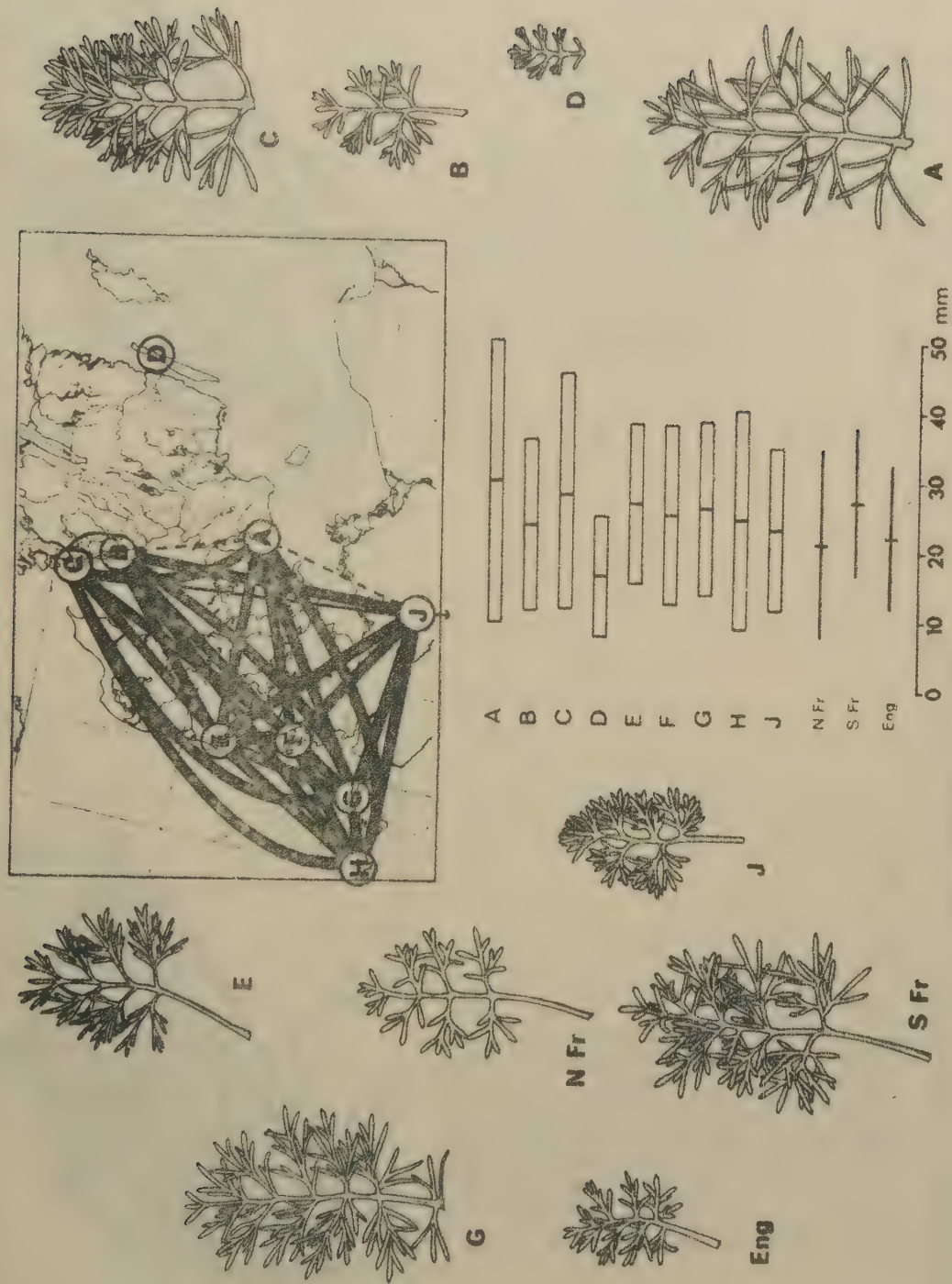


Fig. 64. *Artemisia maritima*. Length of leaf lamina (m+2 s). -- On map the degree of affinity between the grand populations is illustrated (broad line = no significant difference, thin line = ^xsignificant difference, dashed line = ^{xx}significant difference, no connecting line = ^{xxx}significant difference between mean values).

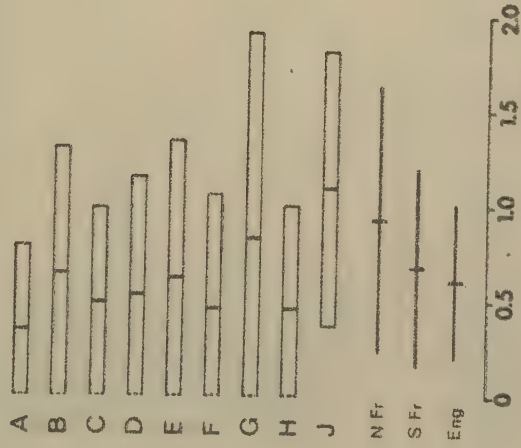


Fig. 65. Artemisia maritima. Degree of leaf segmentation (number of segments on primary segment/length of primary segment) ($m \pm 2$ s).

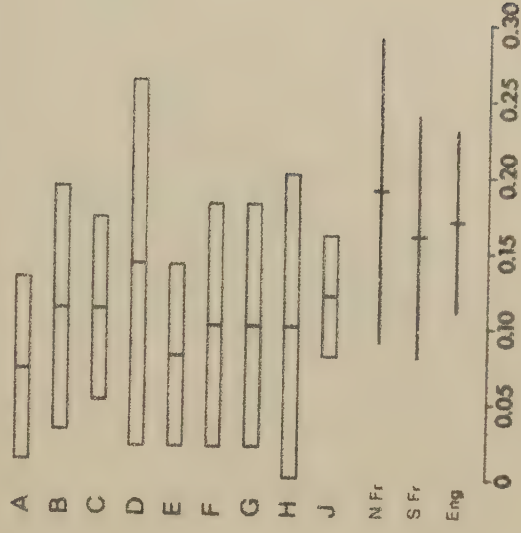
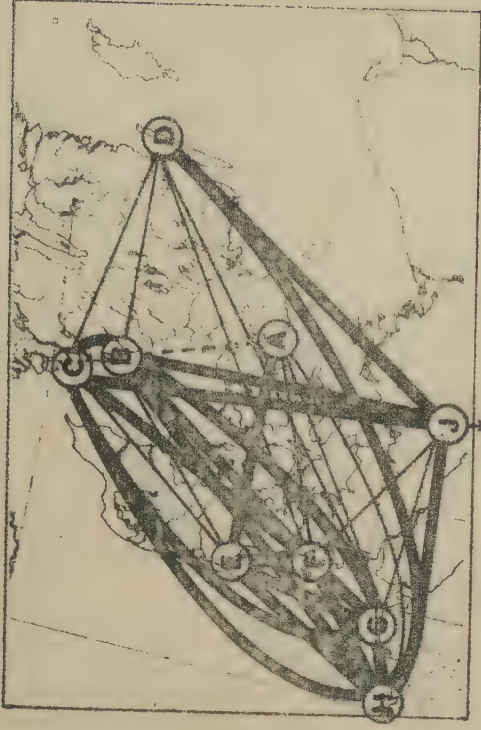


Fig. 66. Breadth/length ratio of secondary leaf segments ($m \pm 2$ s).

On maps the degree of affinity between the grand populations is illustrated (broad line = no significant difference, thin line = ^xsignificant difference, dashed line = ^{xx}significant difference, no connecting line = ^{xxx}significant difference between mean values).

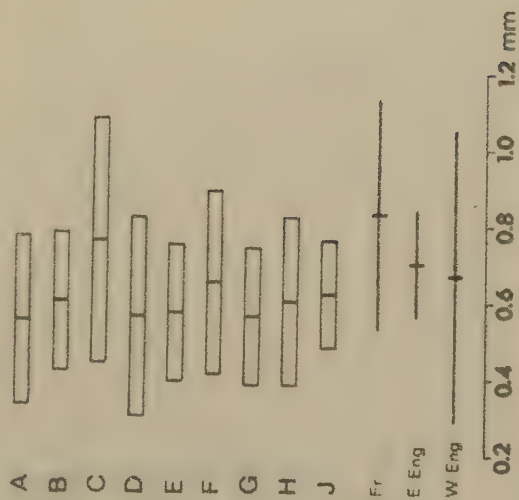
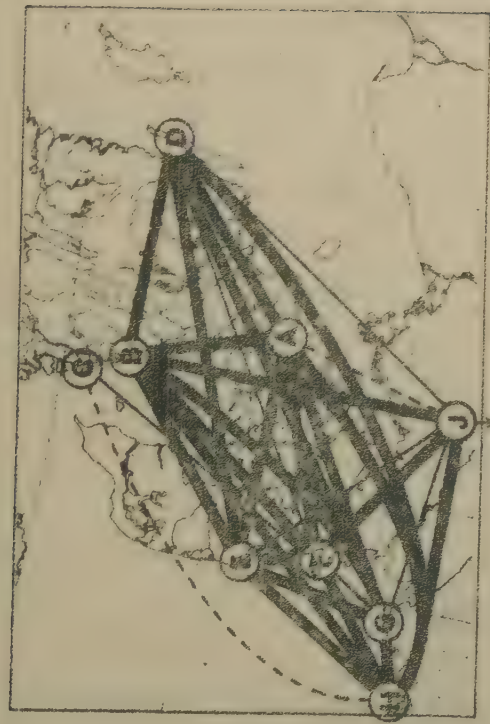


Fig. 67. *Artemisia maritima*. Breadth of secondary leaf segments ($m+2$ s).

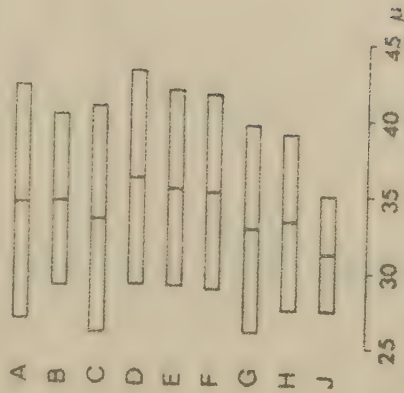


Fig. 68. Stomatal length ($m+2$ s).

On maps the degree of affinity between the grand populations is illustrated (broad line = no significant difference, thin line = ^xsignificant difference, dashed line = ^{xx}significant difference, no connecting line = ^{xxx}significant difference between mean values).

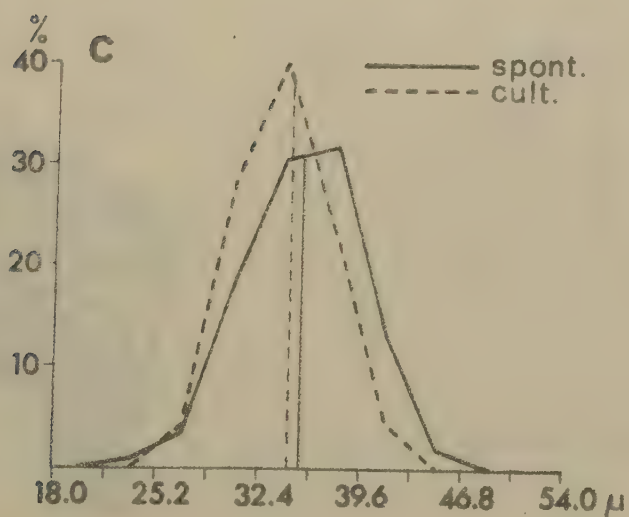
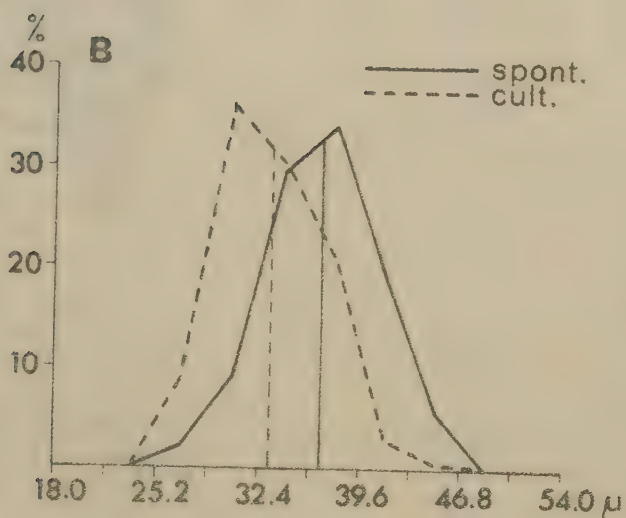
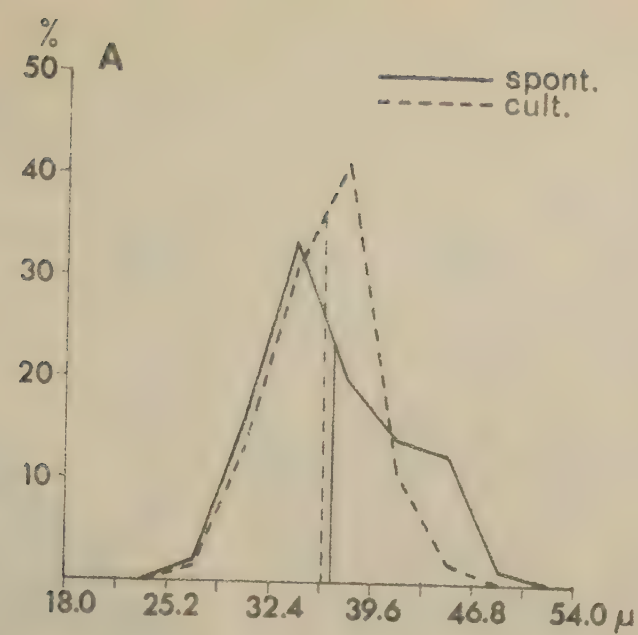


Fig. 69. *Artemisia maritima*. Stomata. Variation in length of guard cells in spontaneous and cultivated material. -- A: Öland--Gotland, Sweden. -- B: Bohuslän, Sweden. -- C: North Sea coast, Germany.

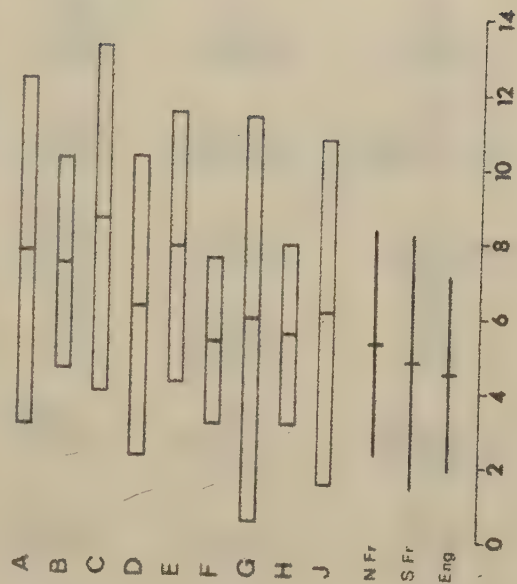
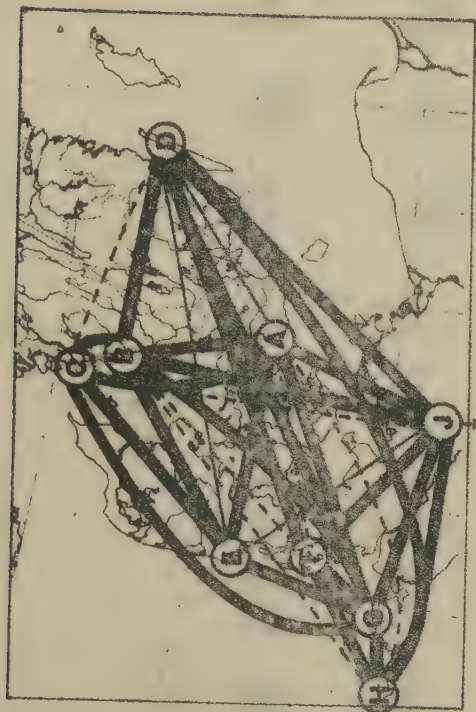
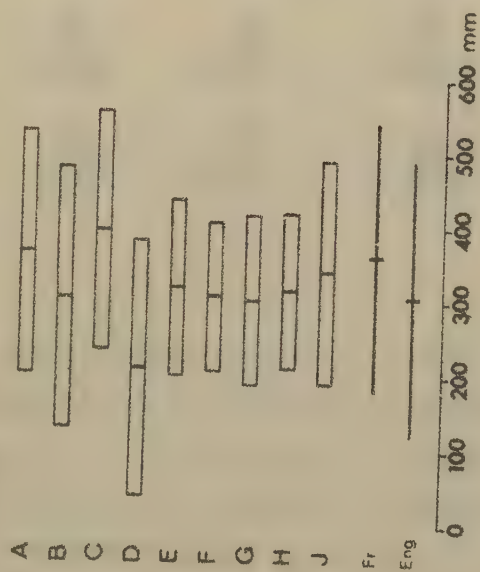
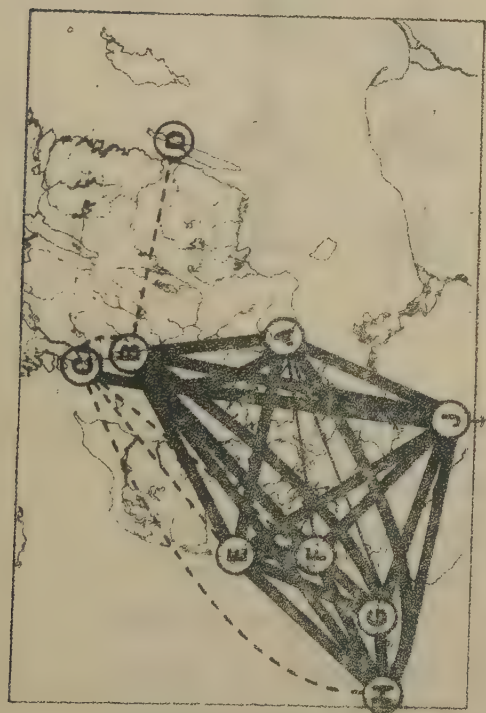


Fig. 70. Artemisia maritima. Shoot length (m+2 s).

Fig. 71. Number of florets per capitulum (m+2 s).

On maps the degree of affinity between the grand populations is illustrated (broad line = no significant difference, thin line = ^xsignificant difference, dashed line = ^{xx}significant difference, no connecting line = ^{xxx}significant difference between mean values).

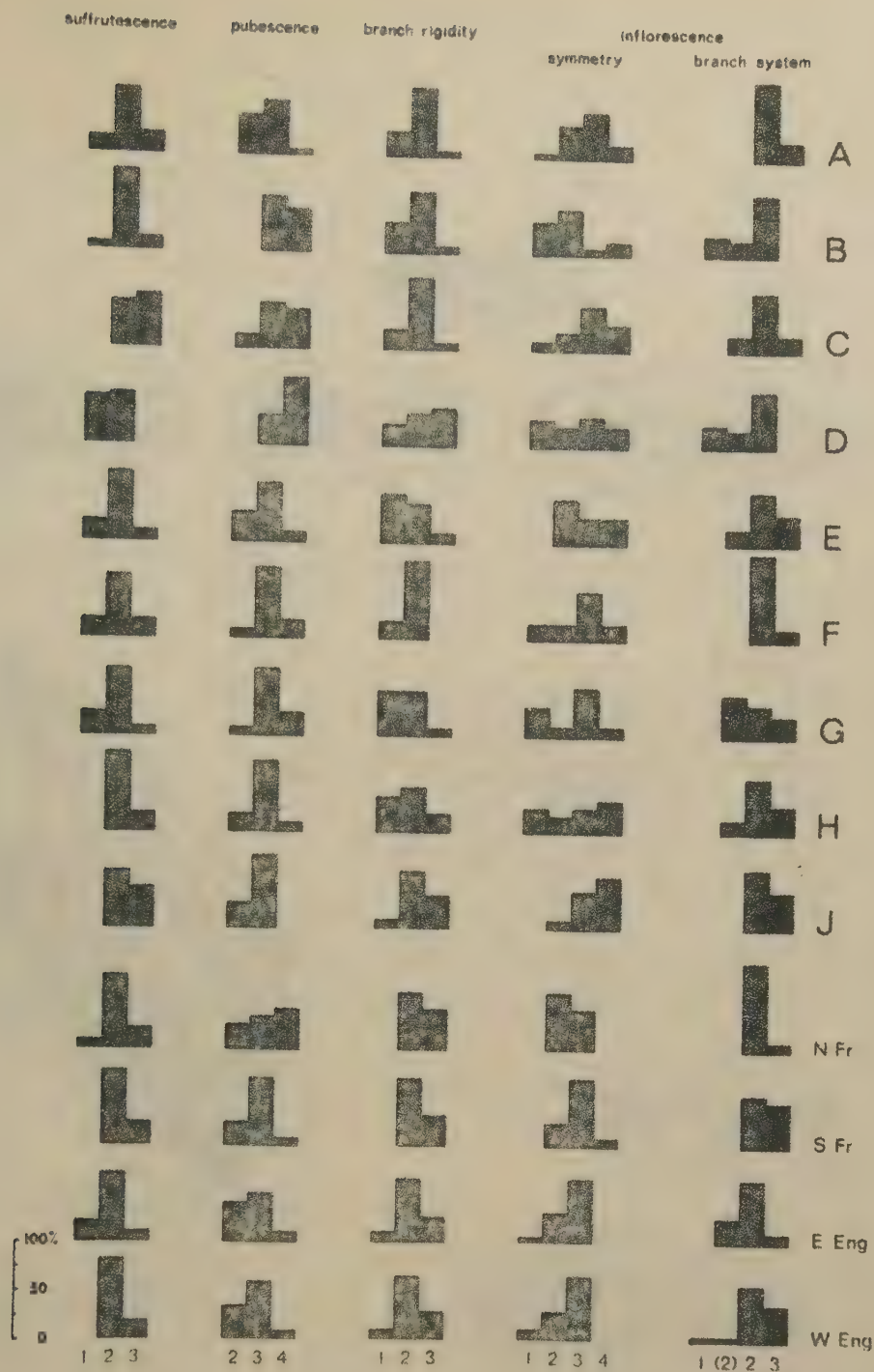


Fig. 72. *Artemisia maritima*. Shoot morphology. -- Group classifications: Suffrutescence: 1 slightly, 2 moderately, 3 strongly suffrutescent. -- Pubescence: 1 almost glabrous, 2 moderately, 3 densely, 4 very densely pubescent. -- Branch rigidity: 1 branches wholly pendent, 2 terminal parts of branches drooping, 3 branches erect. -- Symmetry: 1 wholly secund, 2 largely secund, 3 slightly secund synflorescence, 4 branches diverging in all directions. -- Branching system: 1 no branches, peduncles of primary order, (2) primary branches, single terminal capitula, 2 primary branches, peduncles of secondary order, 3 secondary branches, peduncles of tertiary order.

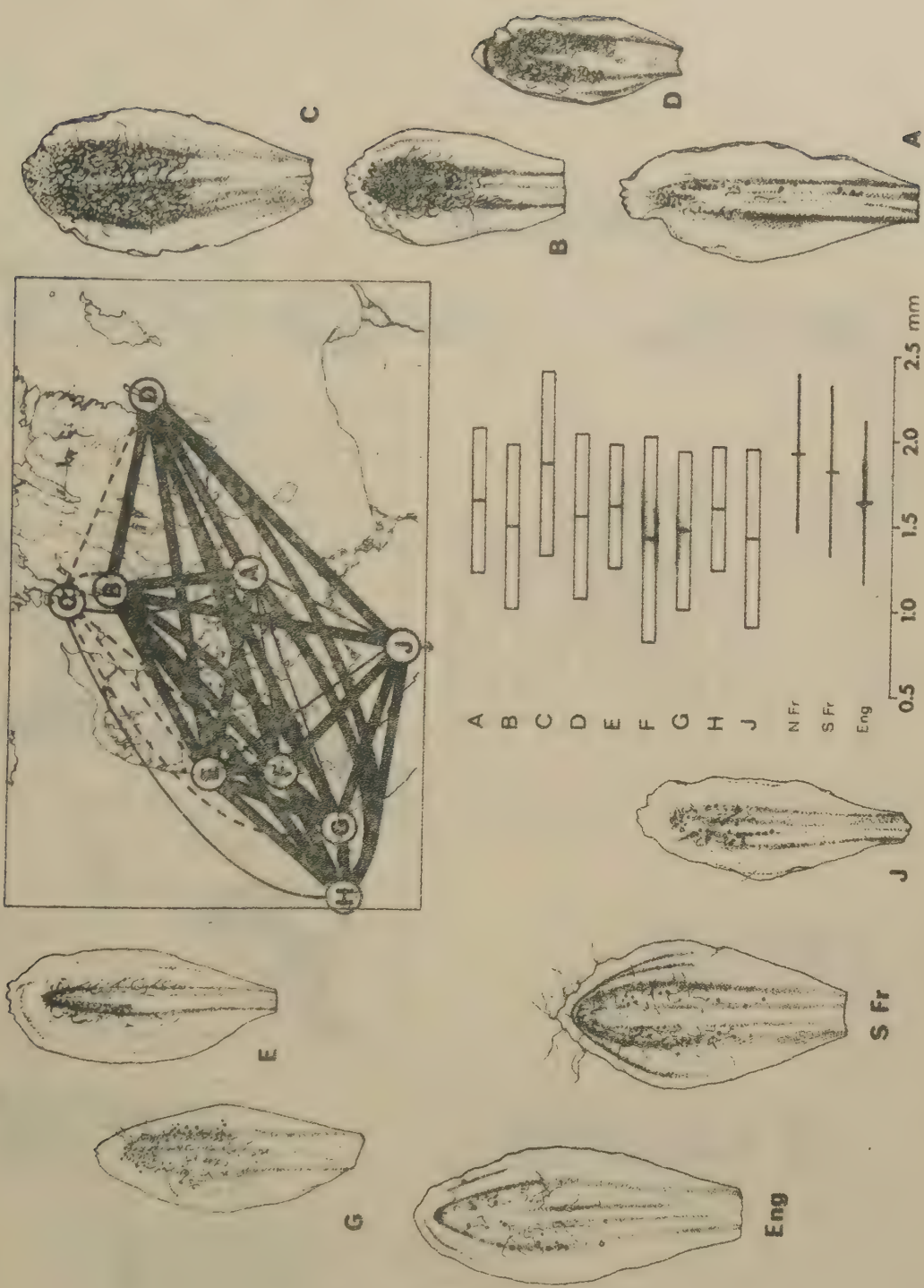


Fig. 73. *Artemisia maritima*. Breadth of inner phyllaries (m+2 s). -- On map the degree of affinity between the grand populations is illustrated (broad line = no significant difference, thin line = ^xsignificant difference, dashed line = ^{xx}significant difference, no connecting line = ^{xxx}significant difference between mean values).

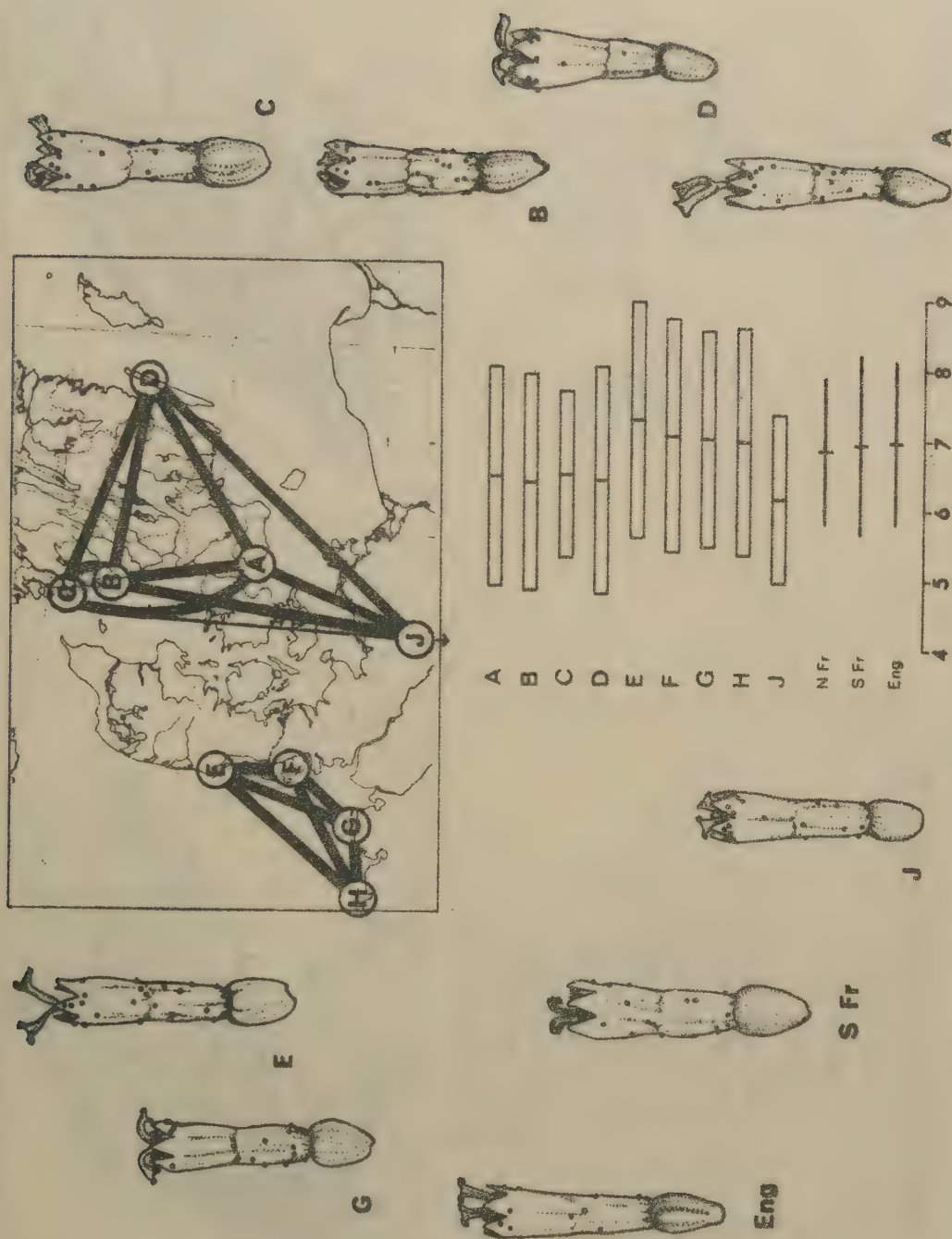


Fig. 74. *Artemisia maritima*. Corolla length/corolla lobe length ratio ($m+2s$). -- On map the degree of affinity between the grand populations is illustrated (broad line = no significant difference, thin line = x significant difference, dashed line = xx significant difference, no connecting line = xxx significant difference between mean values).

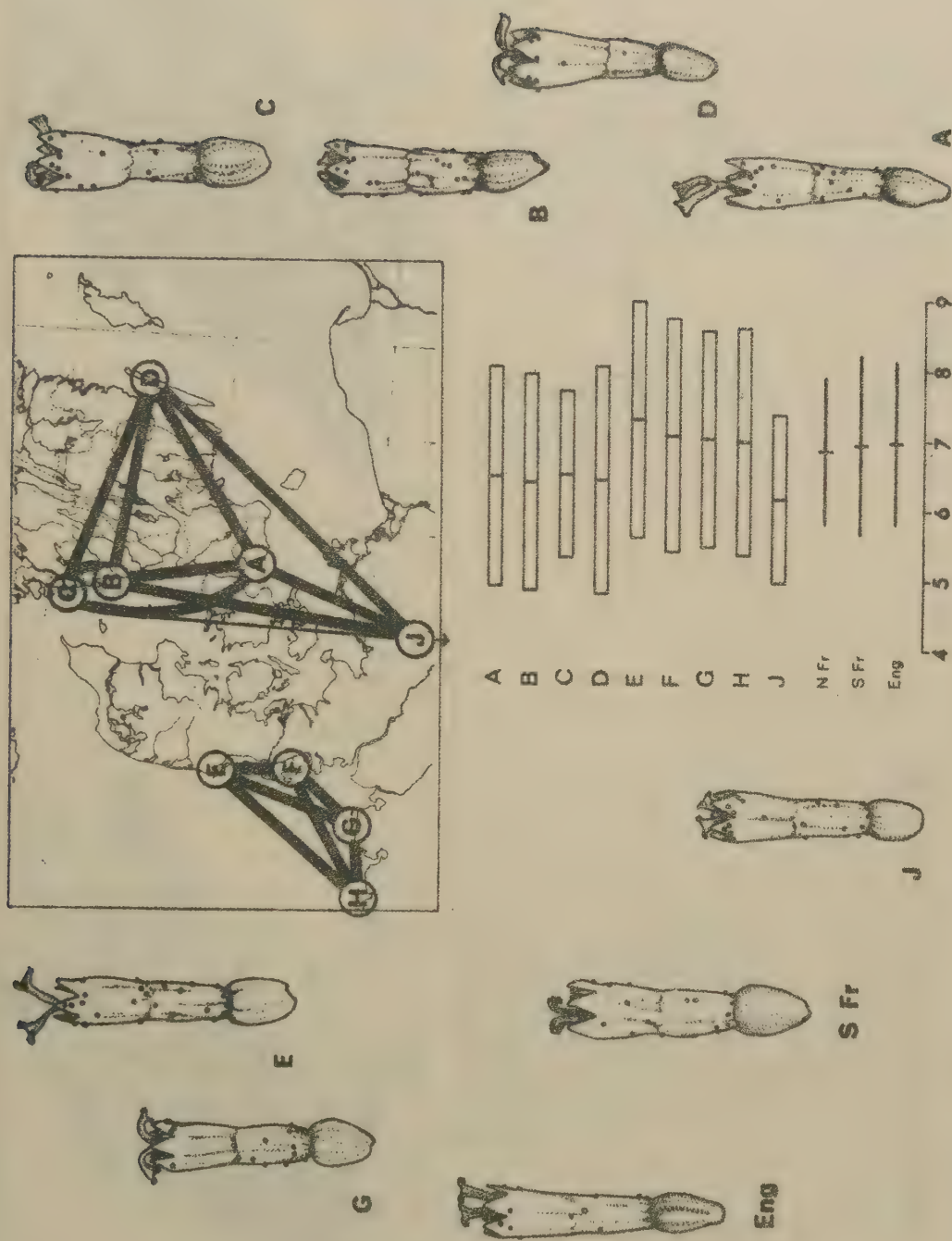


Fig. 74. Artemisia maritima. Corolla length/corolla lobe length ratio ($m+2s$). -- On map the degree of affinity between the grand populations is illustrated (broad line = no significant difference, thin line = $\times$ significant difference, dashed line = $\times\times$ significant difference, no connecting line = $\times\times\times$ significant difference between mean values).

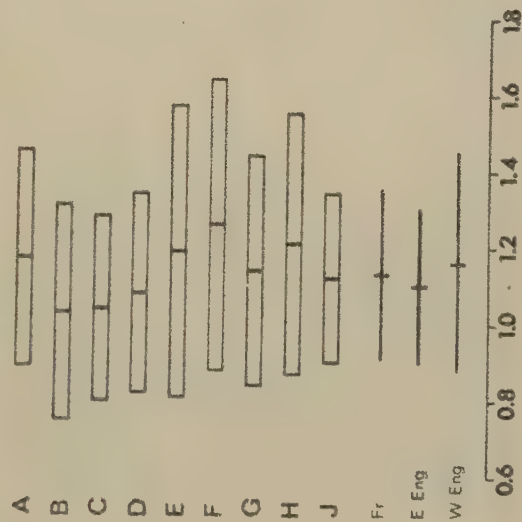
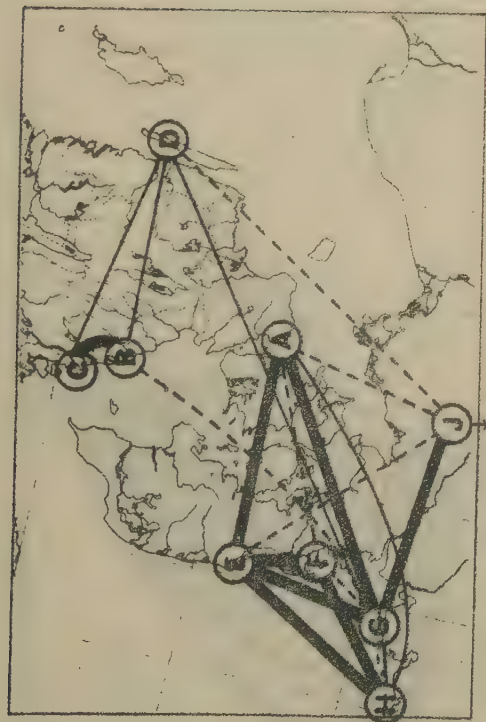


Fig. 75. *Artemisia maritima*. Length/breadth ratio of corolla lobe ($m+2$ s).

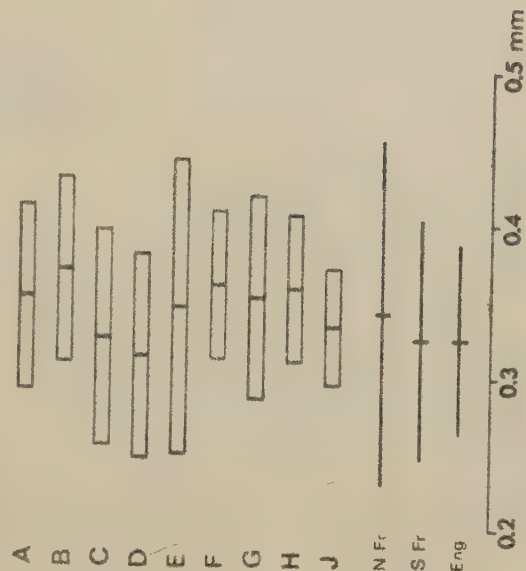
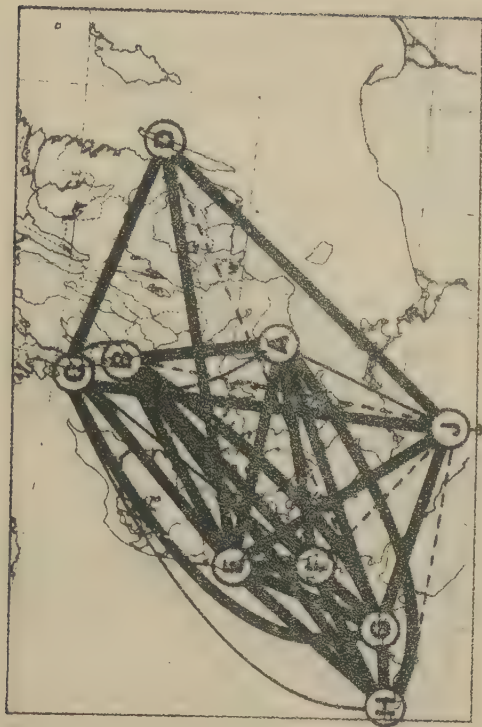


Fig. 76. Length of connective appendage ($m+2$ s).

On maps the degree of affinity between the grand populations is illustrated (broad line = no significant difference, thin line = ^xsignificant difference, dashed line = ^{xx}significant difference, no connecting line = ^{xxx}significant difference between mean values).

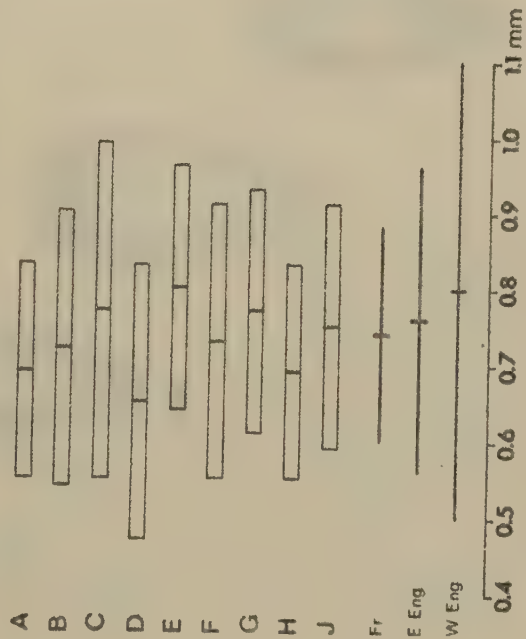
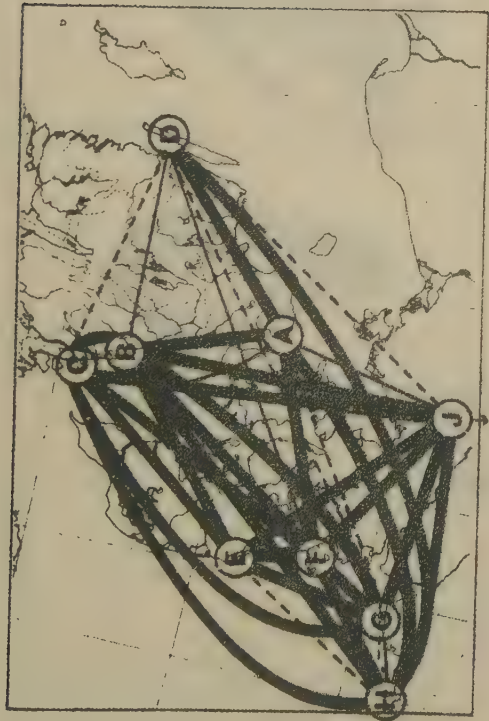


Fig. 77. *Artemisia maritima*. Length of style branch ($m+2 s$).

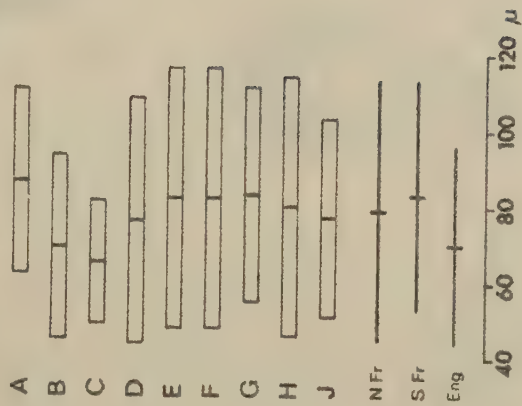
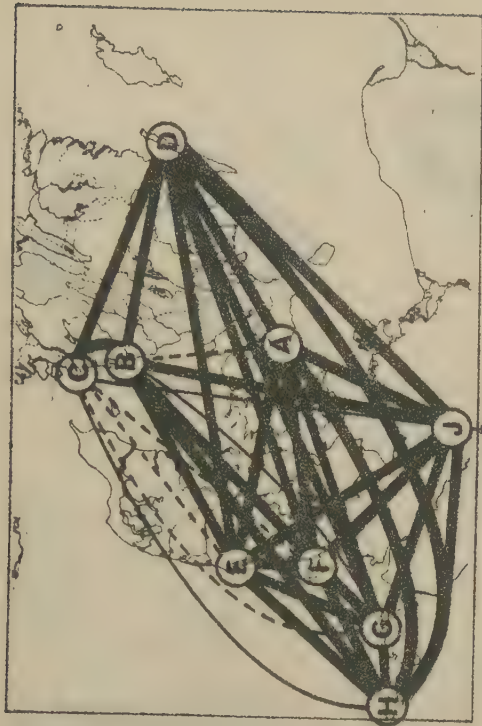


Fig. 78. Breadth of achene ridges ($m+2 s$).

On maps the degree of affinity between the grand populations is illustrated (broad line = no significant difference, thin line = ^xsignificant difference, dashed line = ^{xx}significant difference, no connecting line = ^{xxx}significant difference between mean values).

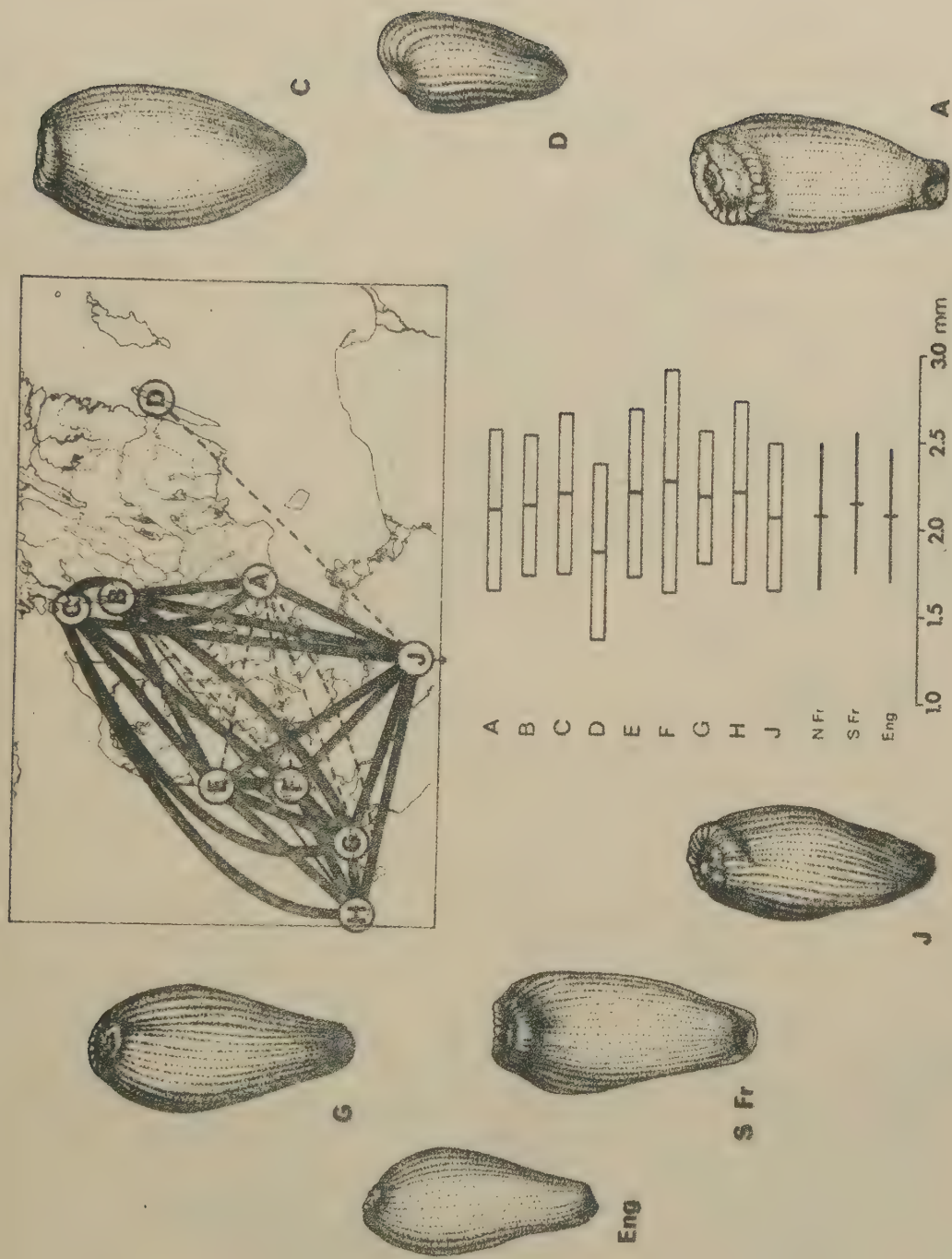


Fig. 79. *Artemisia maritima*. Achene length (m+2 s). -- On map the degree of affinity between the grand populations is illustrated (broad line = no significant difference, thin line = ^xsignificant difference, dashed line = ^{xx}significant difference, no connecting line = ^{xxx}significant difference between mean values).

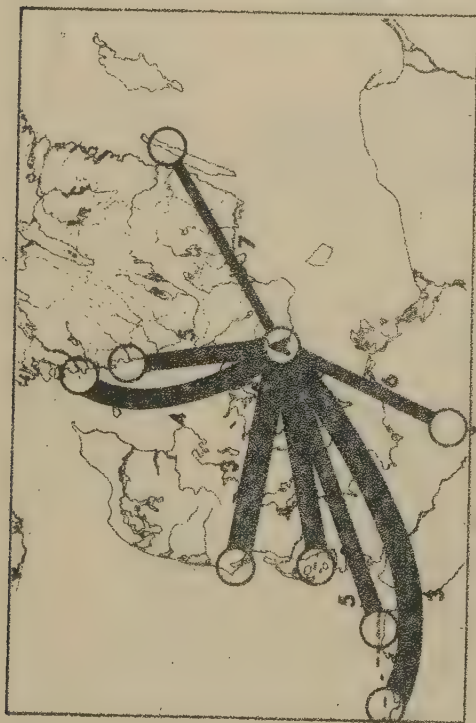




Fig. 80. Artemisia maritima. Each grand population is compared with the rest of the material. The number of characters for which the mean value of the population is significantly different (xx and xxx) is given. The breadth of the connecting lines illustrates the degree of similarity between the populations: the broader the line, the fewer significantly different mean values.

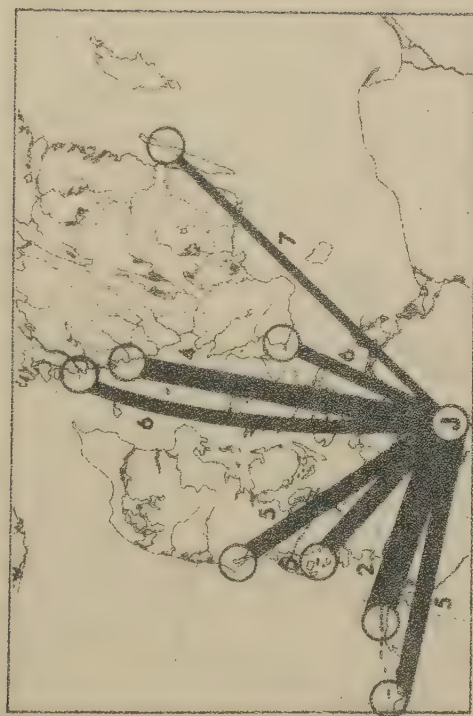


Fig. 80, continued.

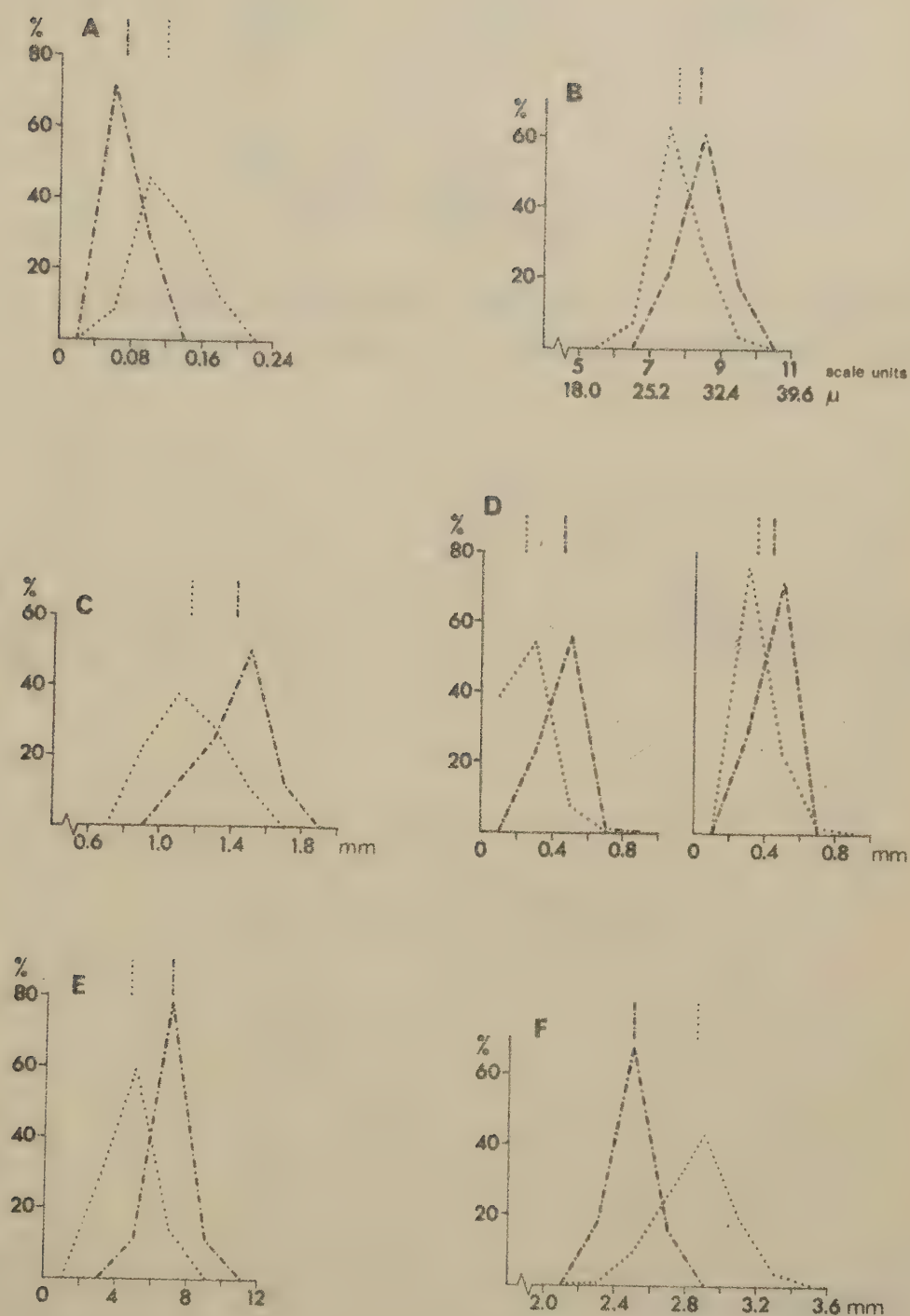


Fig. 81. *Artemisia vallesiaca*. Swiss (.....) and Italian (-----) populations compared. -- A: breadth/length ratio of secondary leaf segments. -- B: stomatal length. -- C: breadth of inner phyllaries. -- D: breadth of scarious margins (left: outer phyllaries, right: inner phyllaries). -- E: number of florets per capitulum. -- F: corolla length.

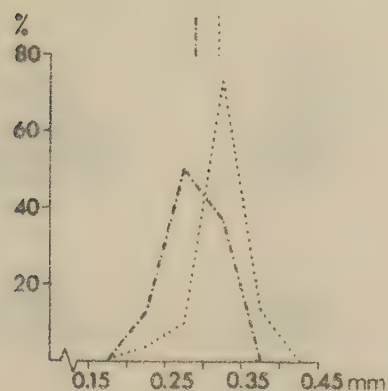


Fig. 82. *Artemisia vallesiaca*. Swiss (.....) and Italian (-----) populations compared. -- Length of connective appendage.

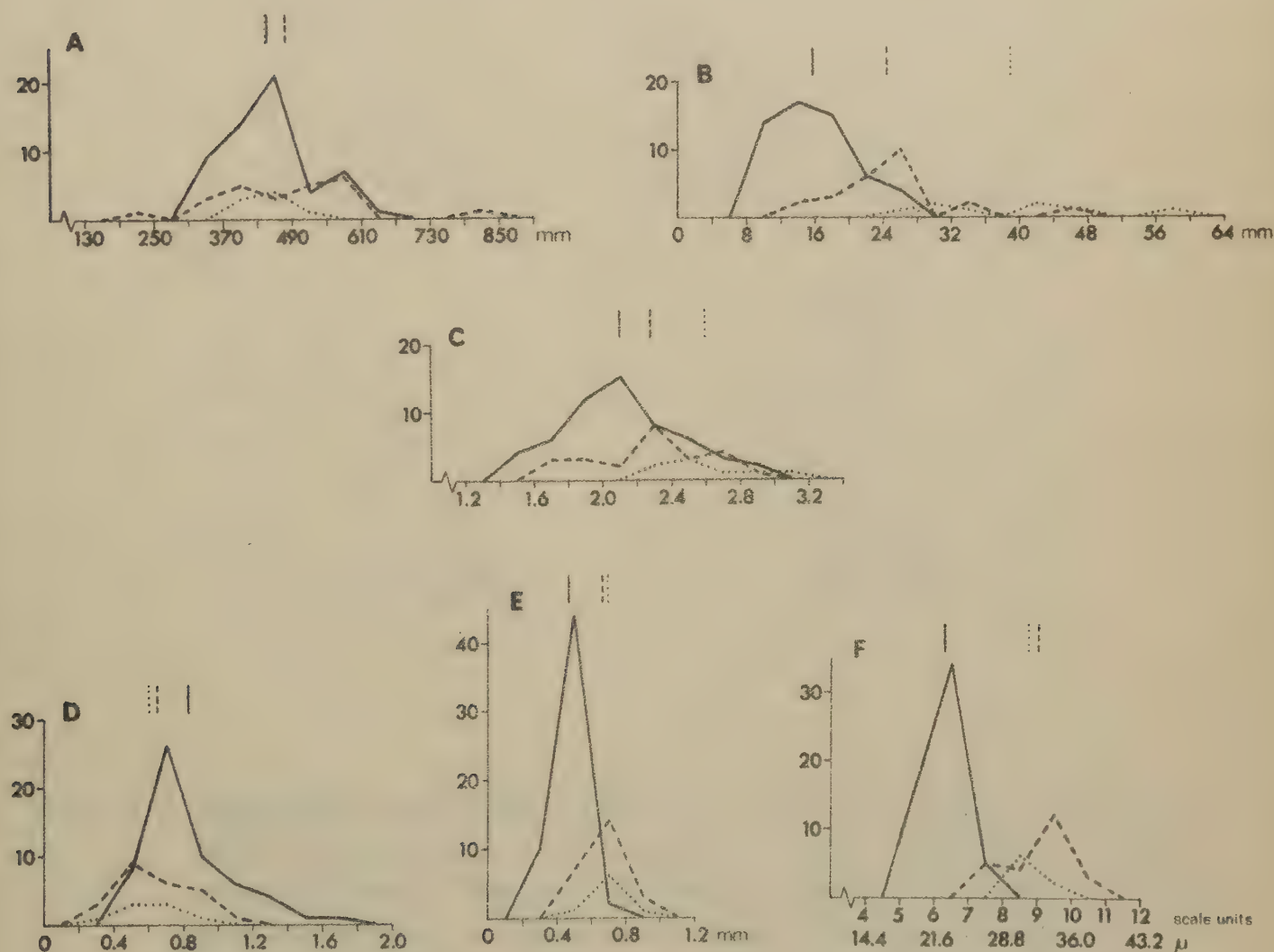


Fig. 83. *Artemisia santonicum*. Diploids (—), tetraploids (-----) and hexaploids (.....) compared. -- A: shoot length. -- B: length of leaf lamina. -- C: leaf lamina length/primary segment length ratio. -- D: degree of leaf segmentation (number of segments on primary segment/length of primary segment). -- E: breadth of secondary leaf segments. -- F: stomatal length. -- On vertical axis number of plants.

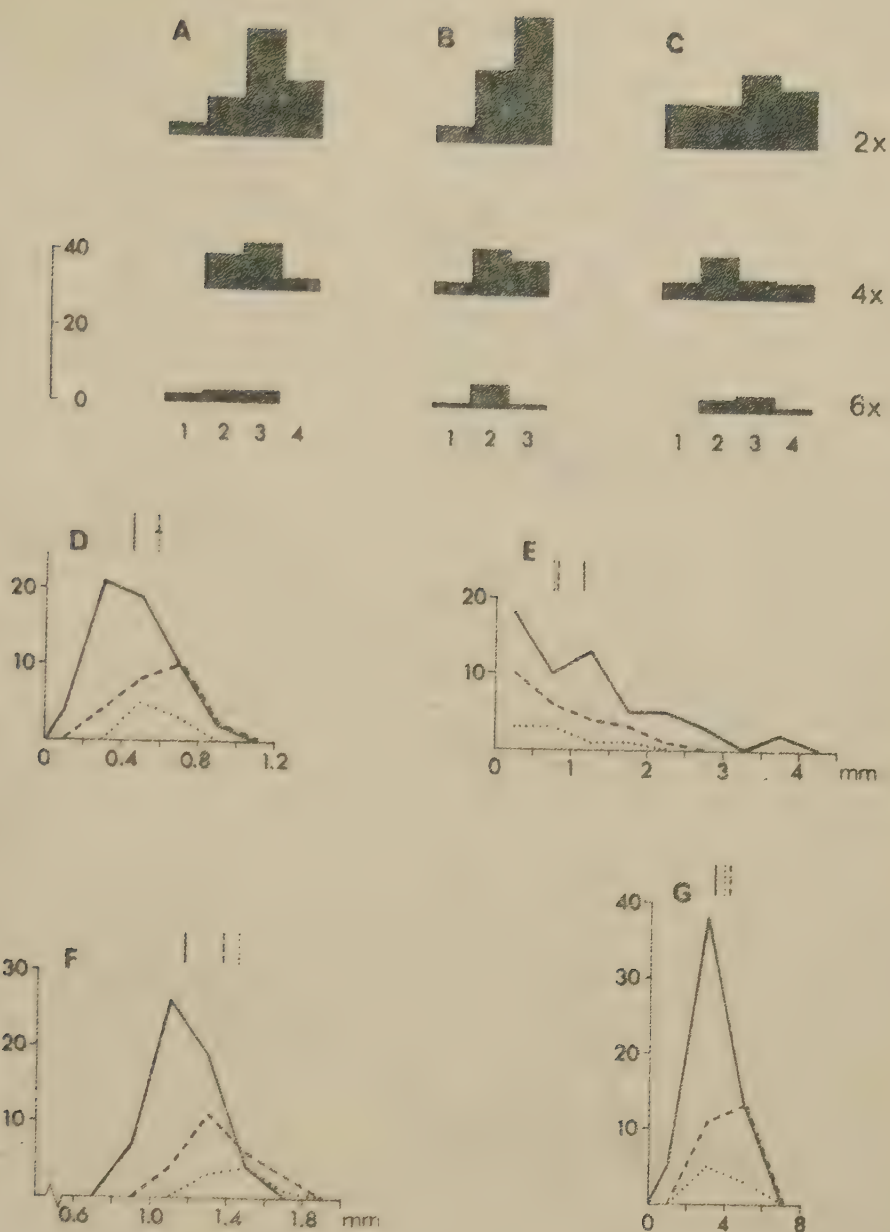


Fig. 84. *Artemisia santonicum*. Diploids (—), tetraploids (-----) and hexaploids (.....) compared. -- A: synflorescence symmetry (1 wholly secund, 2 largely secund, 3 slightly secund synflorescence, 4 branches diverging in all directions). -- B: degree of branch rigidity (1 branches wholly pendent, 2 terminal part of branches drooping, 3 branches erect). -- C: position of capitula on branches (1 unilateral position, 2 mixed condition, more like 1, 3 mixed condition, more like 4, 4 multilateral position). -- D: number of capitula per mm on branches. -- E: peduncle length. -- F: breadth of inner phyllaries. -- G: number of florets per capitulum. -- On vertical axis number of plants.

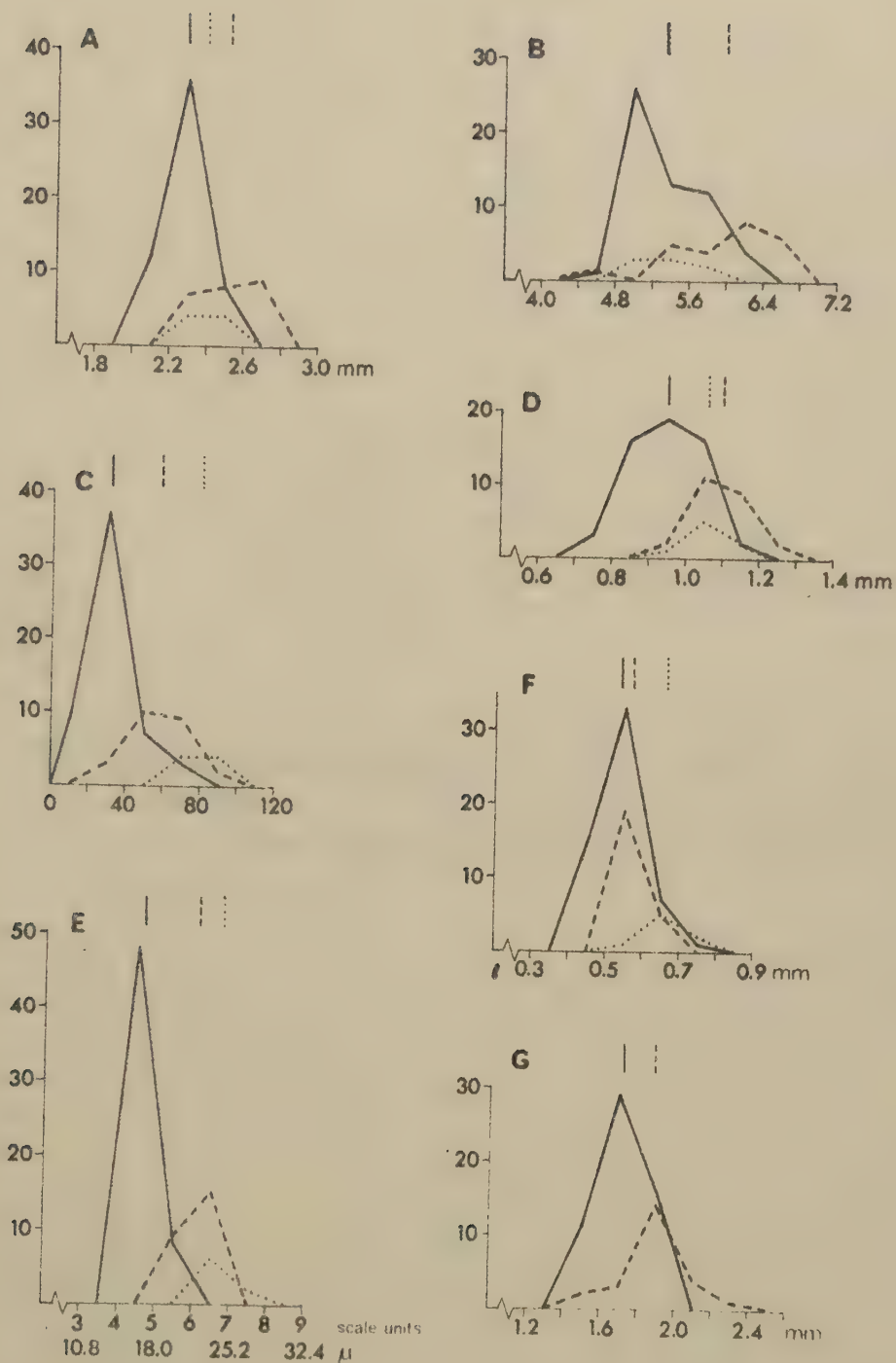


Fig. 85. *Artemisia santonicum*. Diploids (—), tetraploids (-----) and hexaploids (.....) compared. -- A: corolla length. -- B: corolla length/corolla lobe length ratio. -- C: number of glands per floret. -- D: theca length. -- E: pollen diameter. -- F: length of style branch. -- G: achene length. -- On vertical axis number of plants.

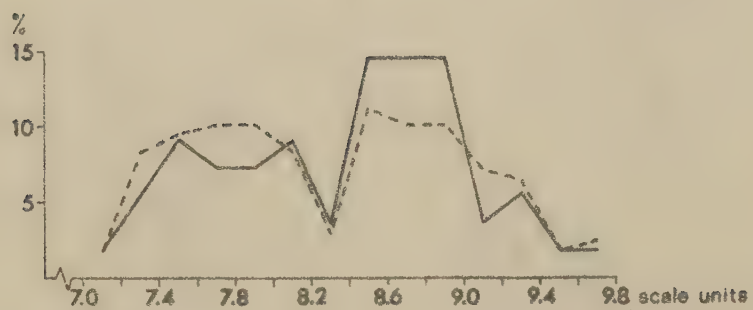


Fig. 86. Artemisia santonicum. Pollen diameter in herbarium material (—— mean diameter in each locality, ----- mean diameter in each individual). -- 1 scale unit = 2.5μ .

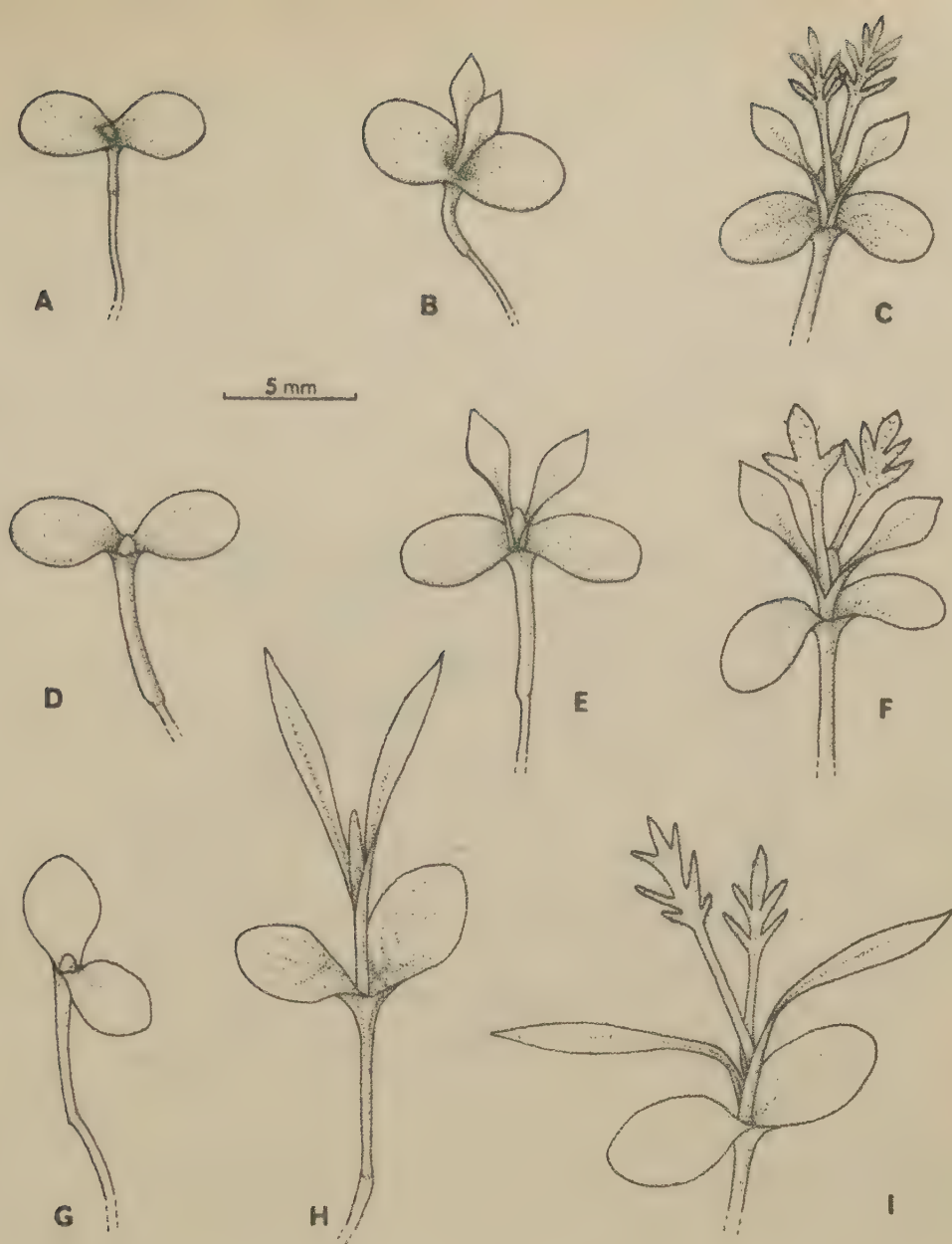


Fig. 87. Seedling development. -- A--C: Artemisia santonicum (diploid). -- D--F: A. santonicum (tetraploid). -- G--I: A. vallesiaca.

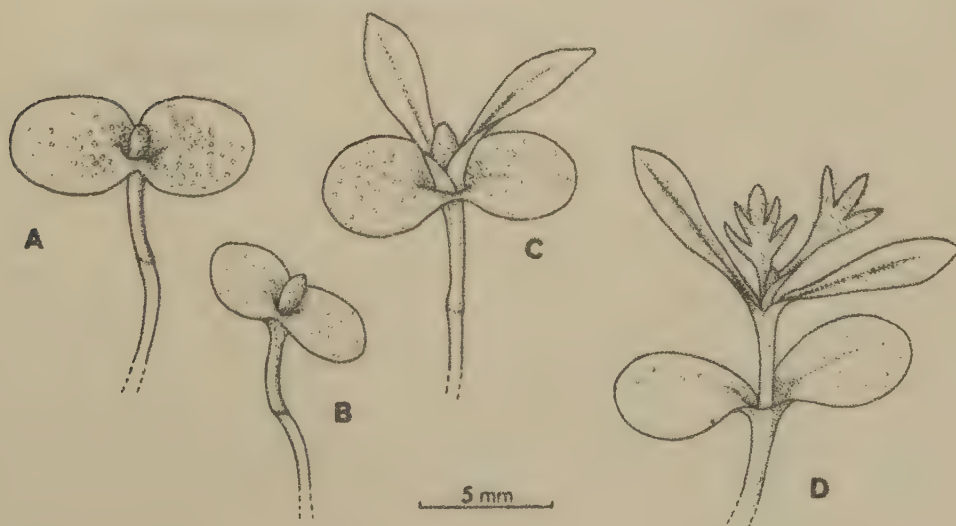


Fig. 88. Seedling development in Artemisia maritima. -- A, C, D: Nordfriesland, Germany. -- B: Öland, Sweden.



Fig. 89. Localities of achene collections used in investigation on germination and tolerance to salinity. -- A: Artemisia santonicum (diploid). -- B--E: A. maritima.

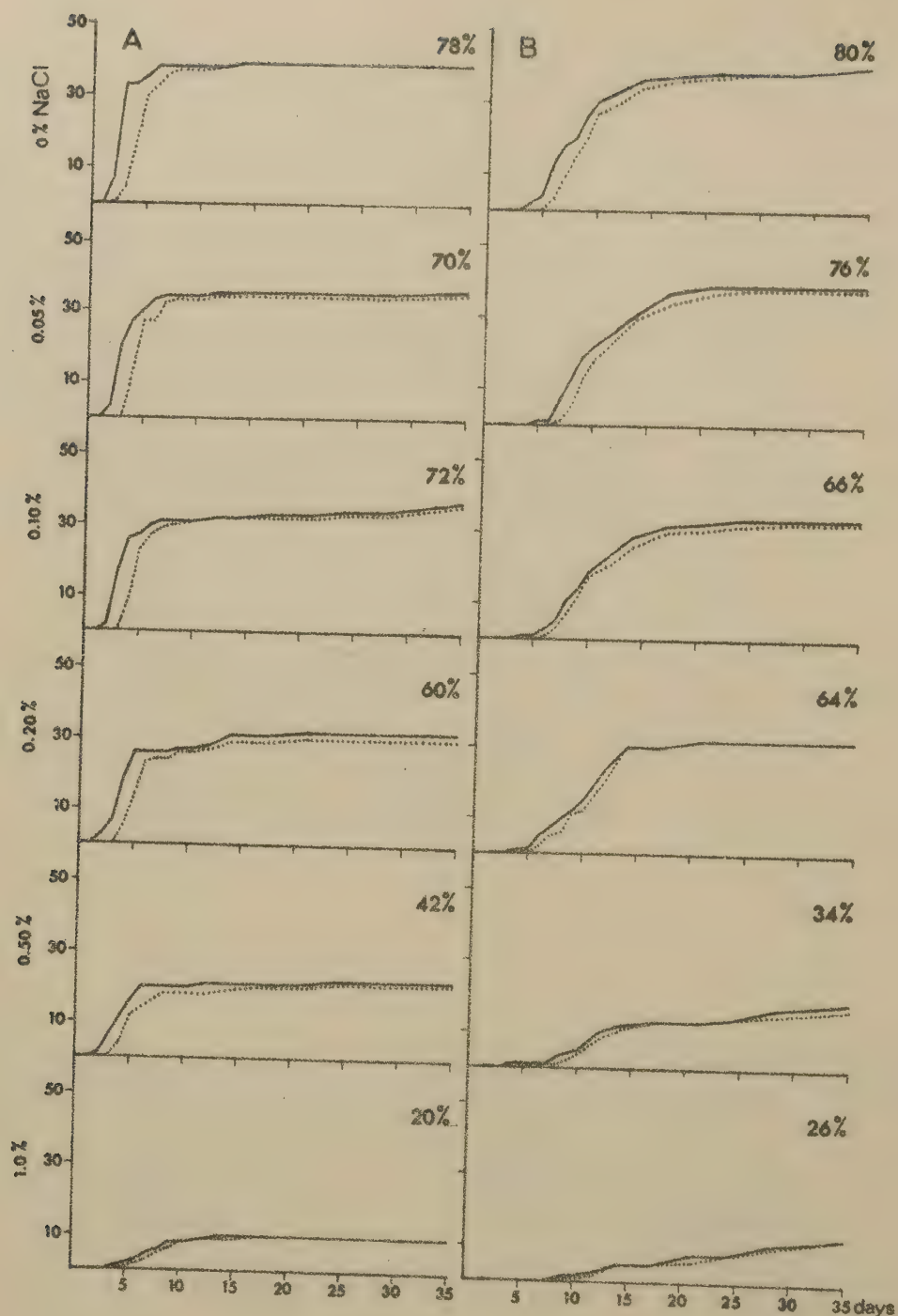


Fig. 90. Germination in different concentrations of sodium chloride. 50 achenes were used in each test. -- — Number of achenes developing radicle, number of achenes developing both radicle and hypocotyl (the final frequencies of these are given in the upper right corner of the diagrams). -- A: *Artemisia santonicum* from Czechoslovakia. -- B--E: *A. maritima* from Skåne, Sweden (B), Öland, Sweden (C), Bohuslän, Sweden (D), and Nordfriesland, Germany (E).

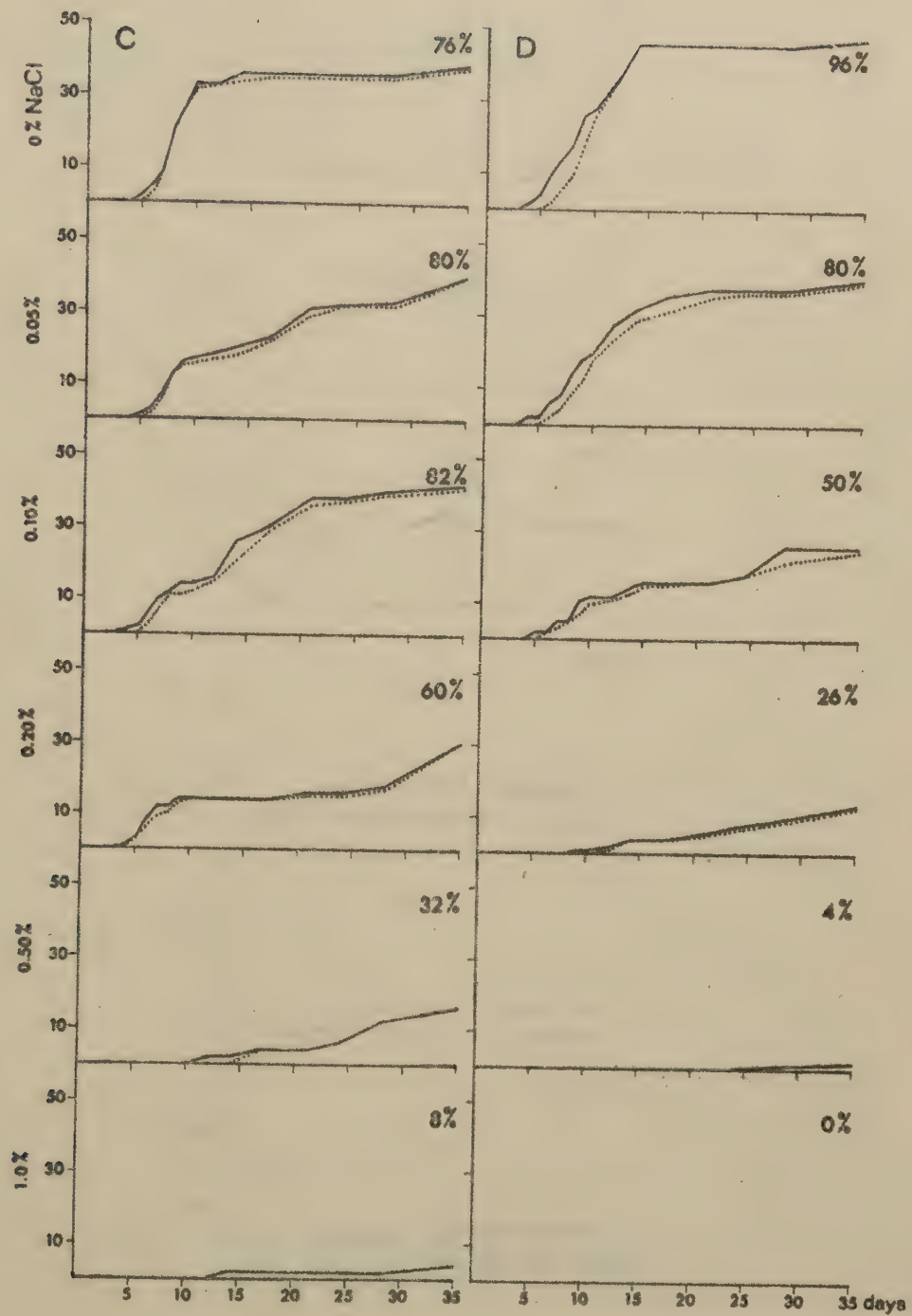


Fig. 90, continued.

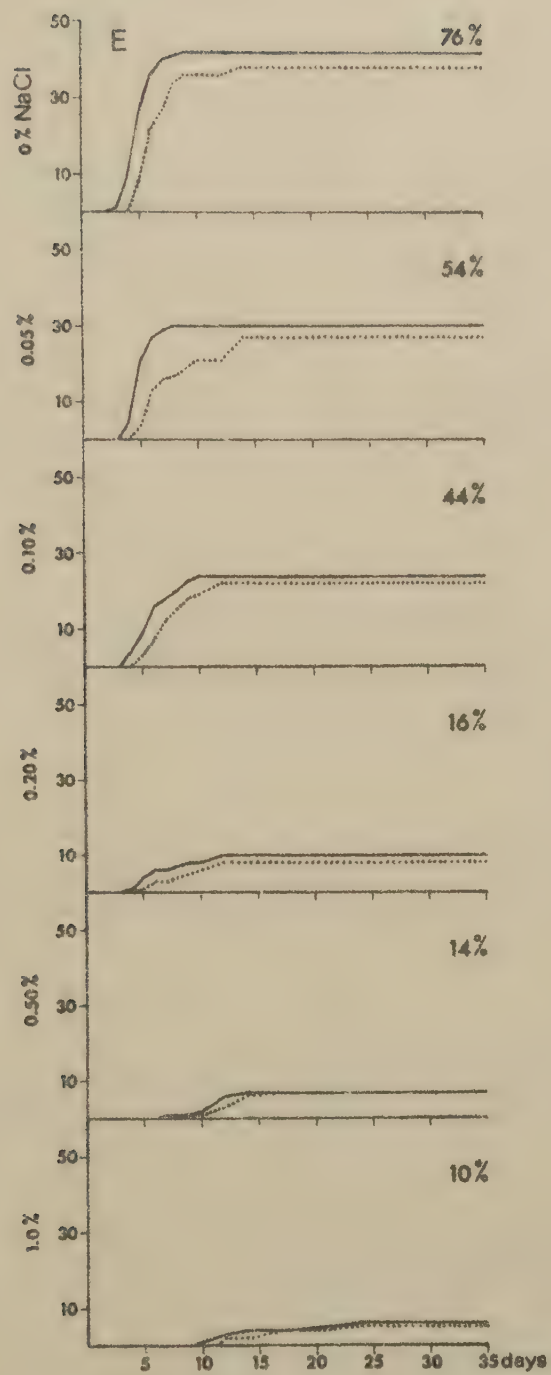


Fig. 90, continued.

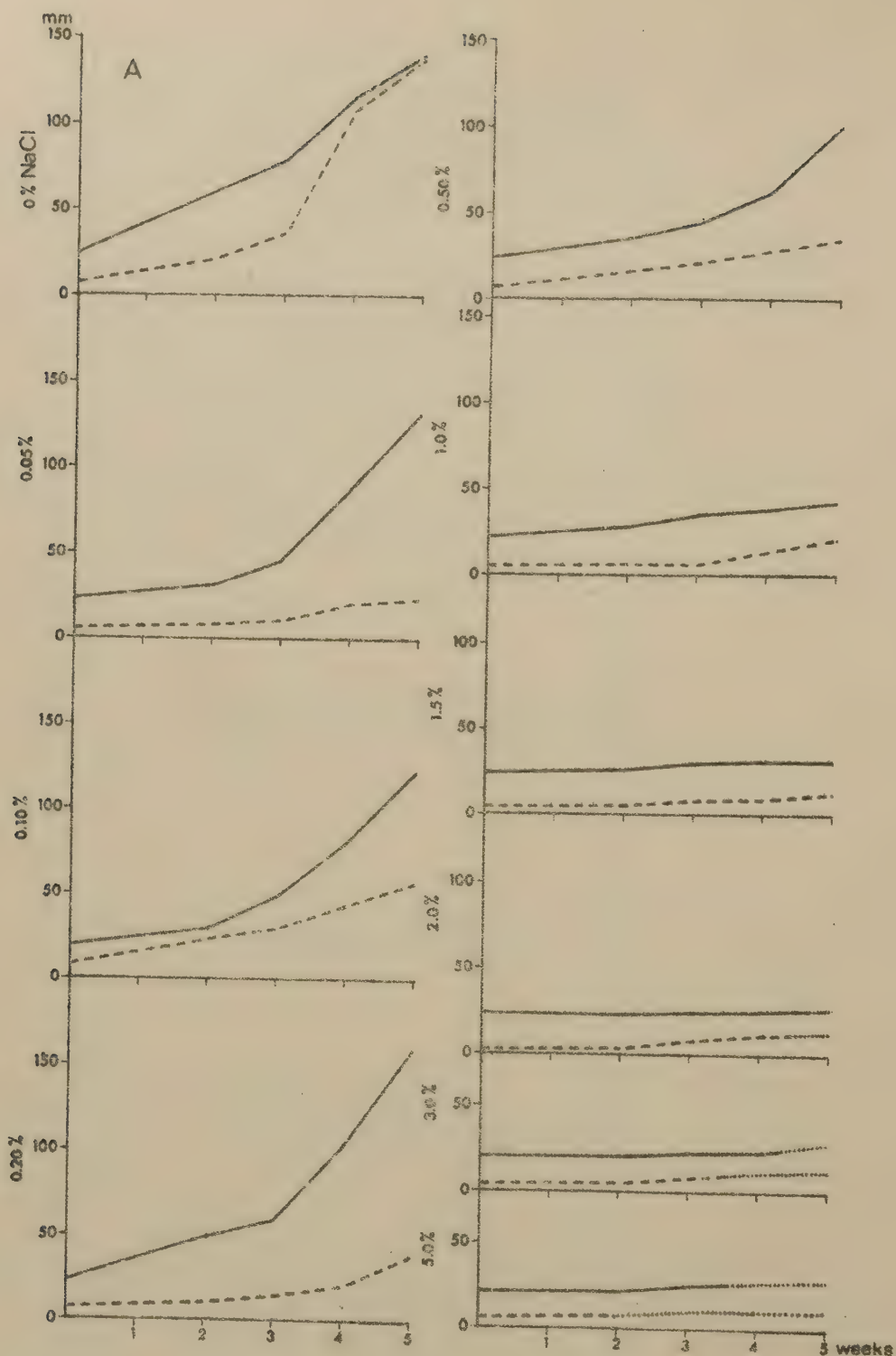


Fig. 92. Shoot growth of seedlings in different concentrations of sodium chloride (— seedlings eight weeks old at beginning of experiment, ---- seedlings four weeks old at beginning of experiment, wilting). -- A: *Artemisia santonicum* from Czechoslovakia. -- B--E: *A. maritima* from Skåne, Sweden (B), Öland, Sweden (C), Bohuslän, Sweden (D), and Nordfriesland, Germany (E).

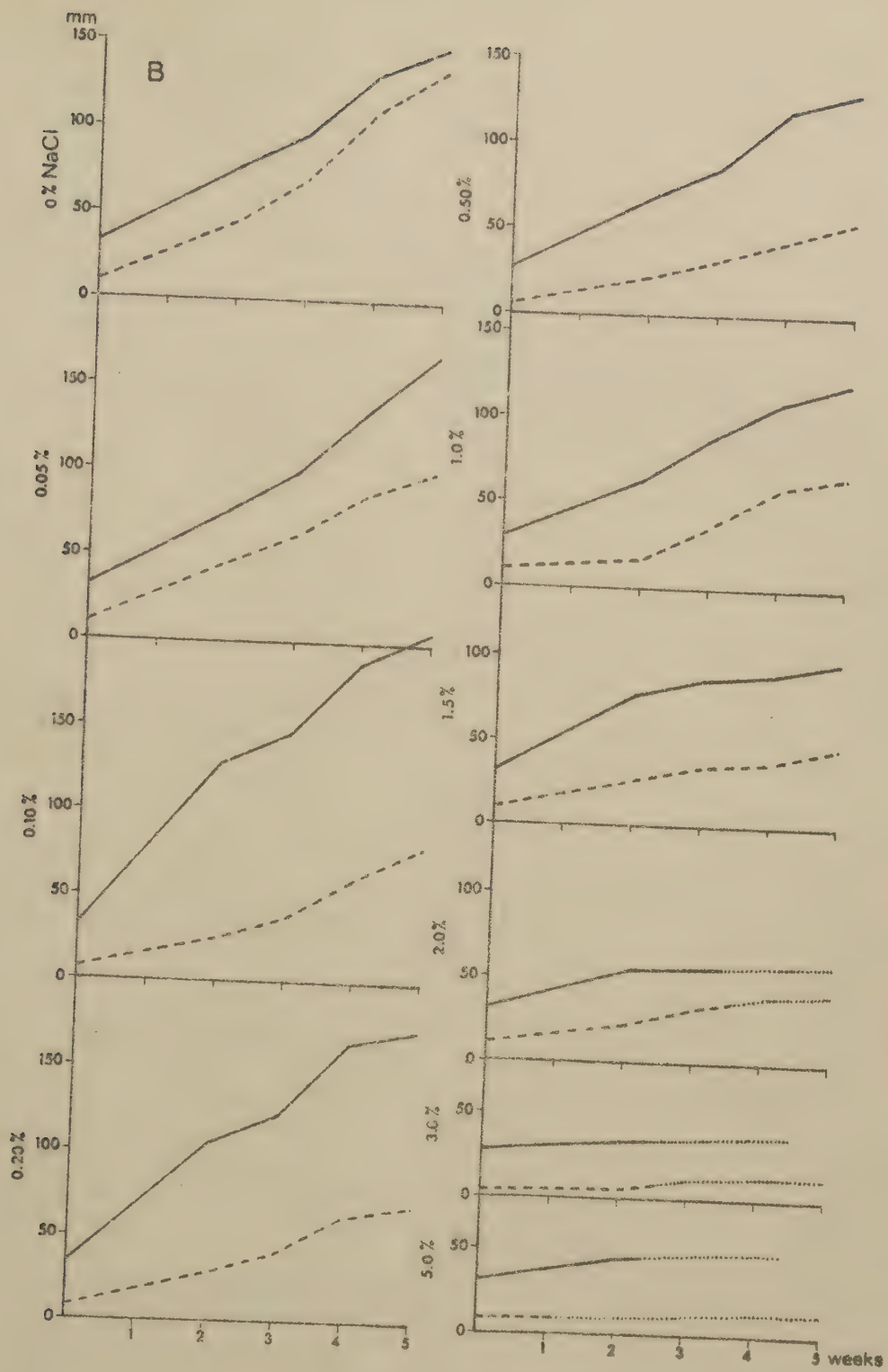


Fig. 92, continued.

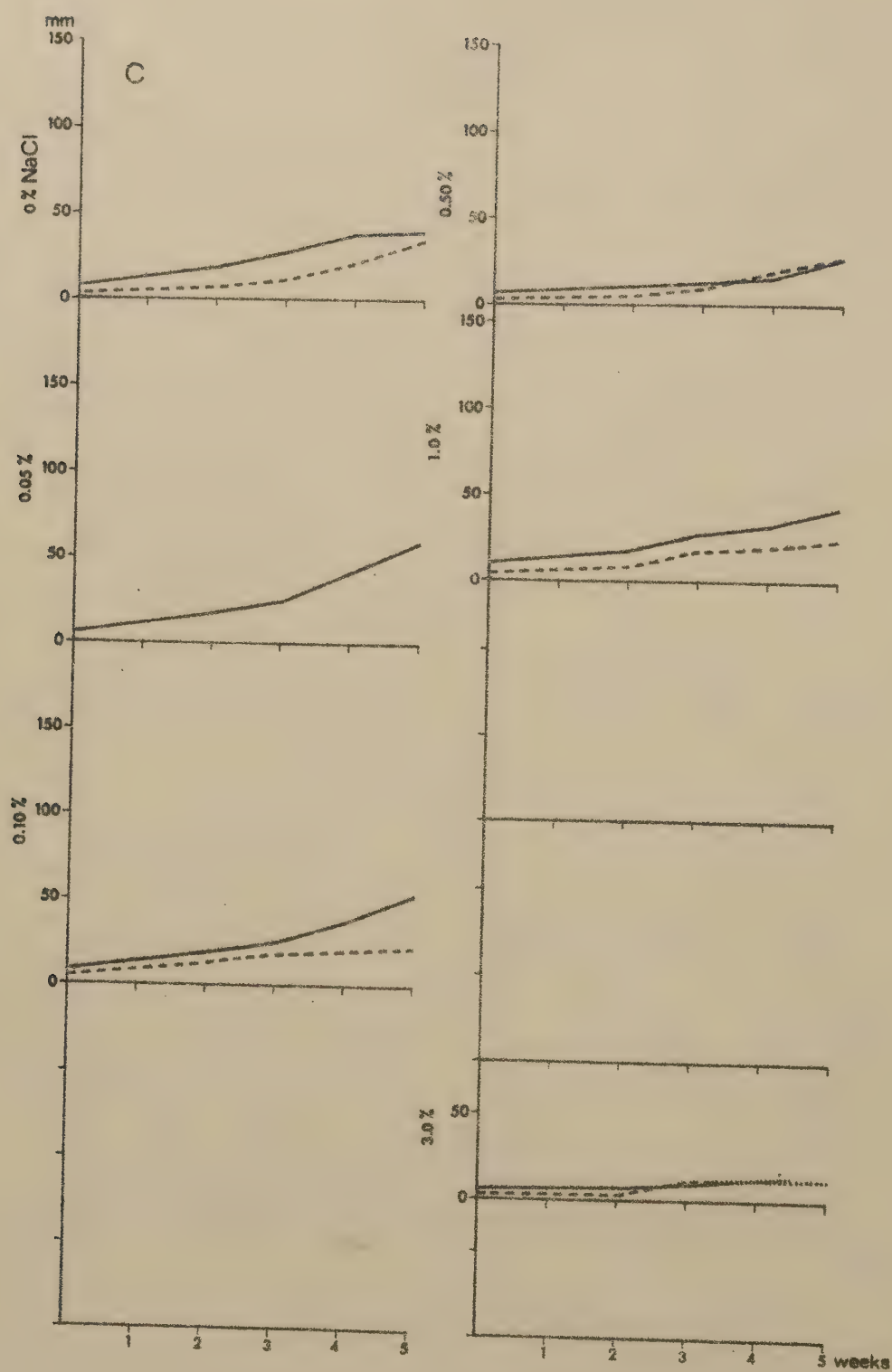


Fig. 92, continued.

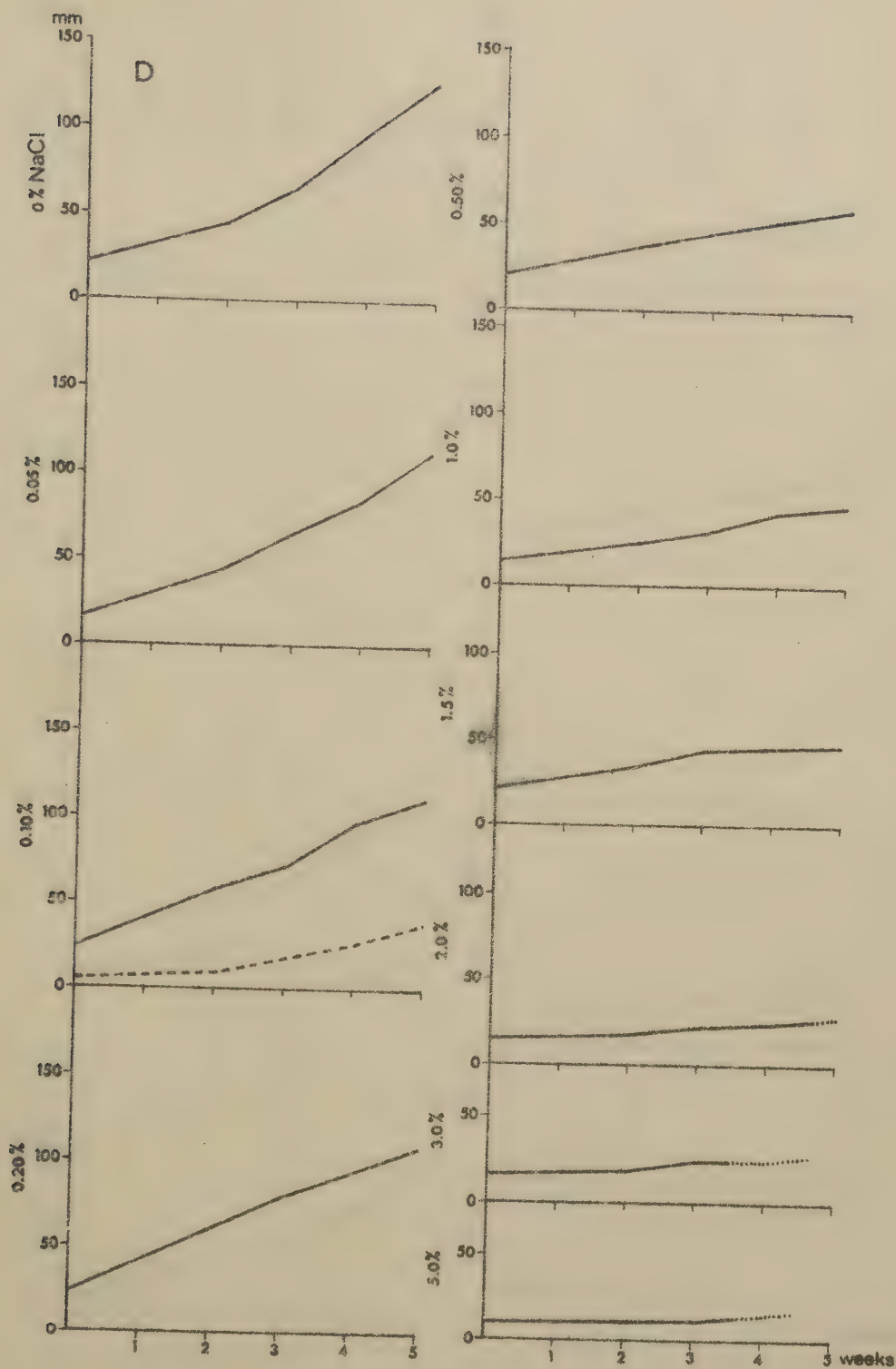


Fig. 92, continued.

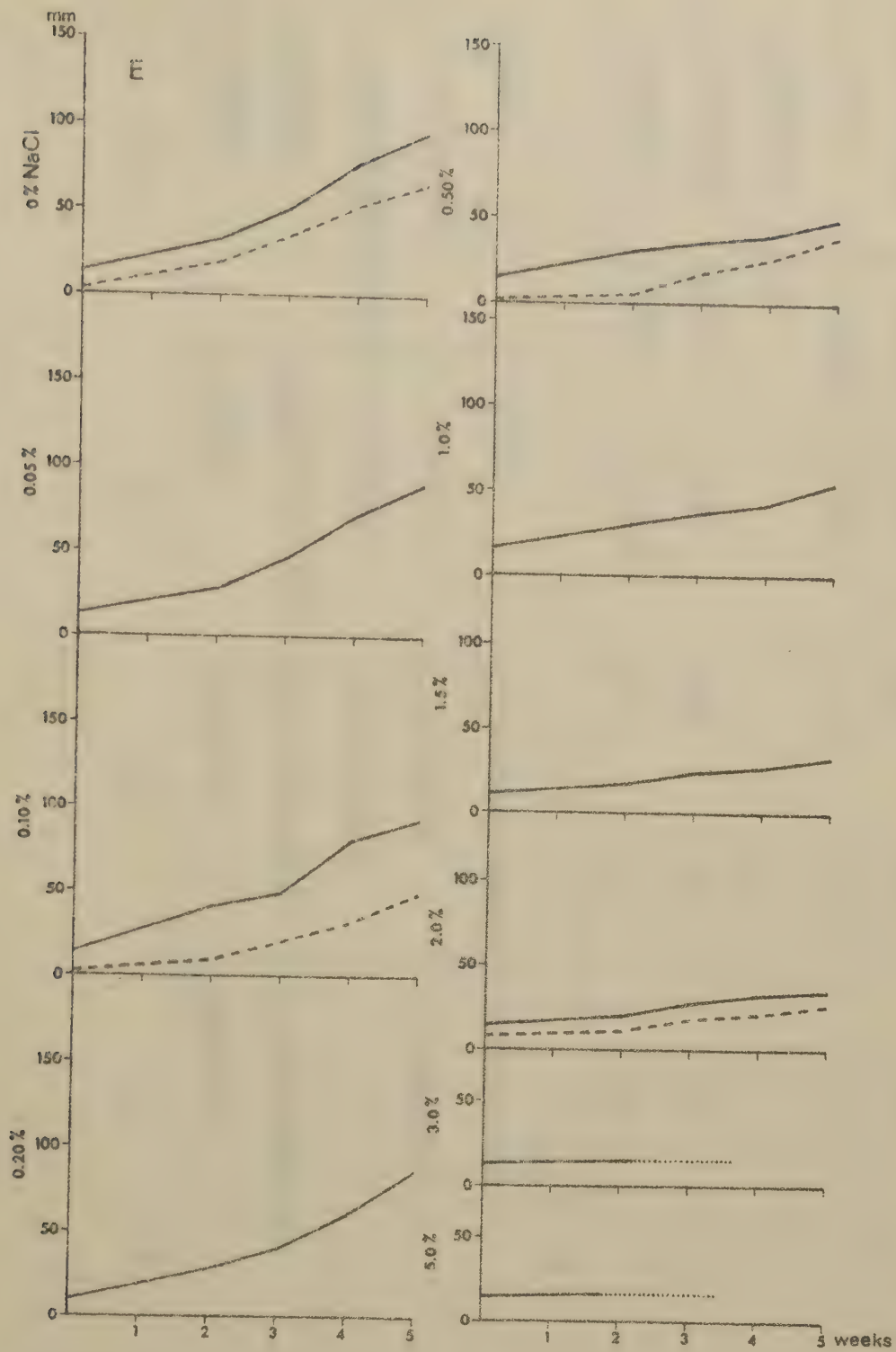


Fig. 92, continued.

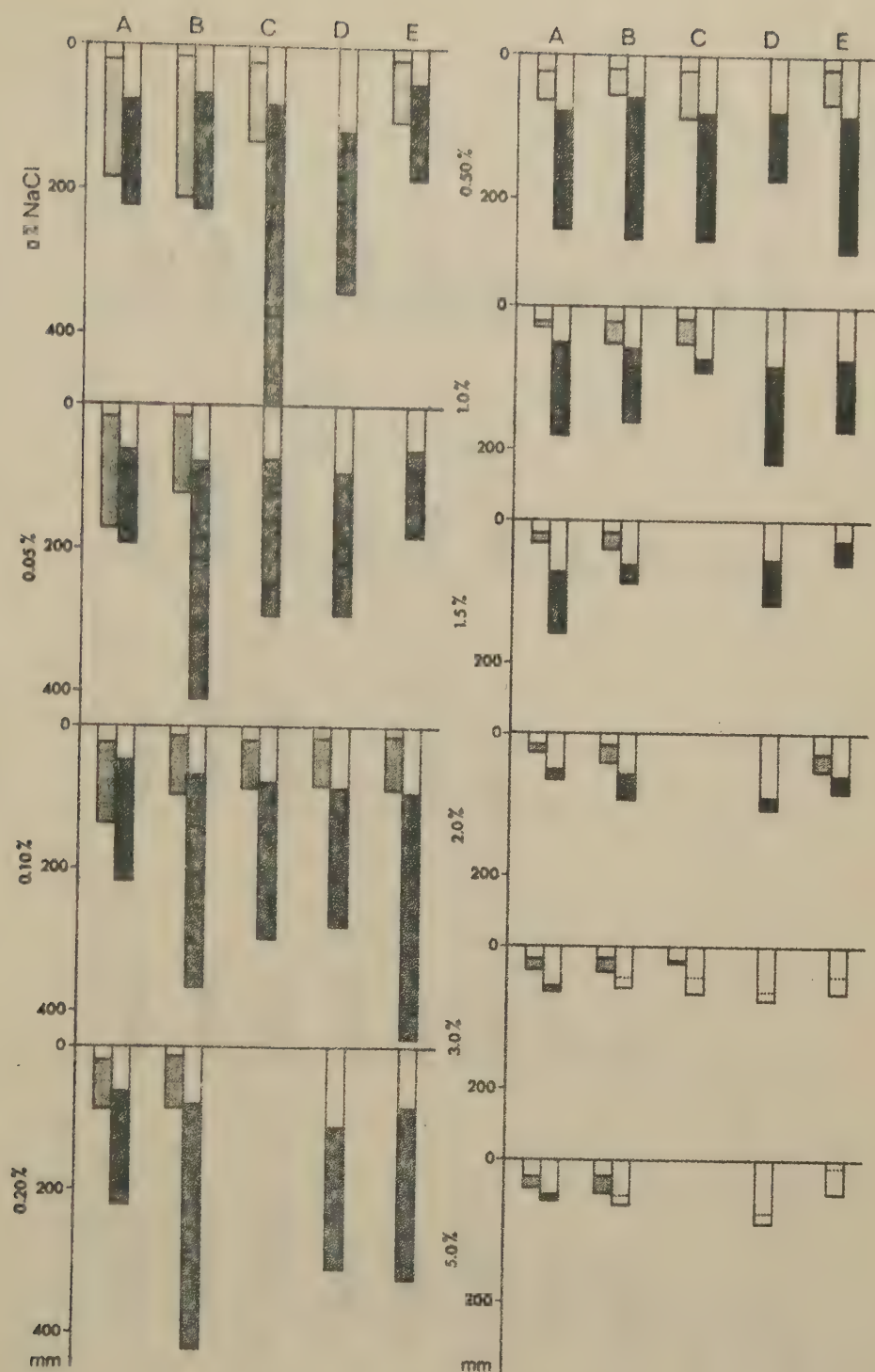


Fig. 93. Growth of root system of seedlings in different concentrations of sodium chloride. Length of roots at beginning of experiment (white bars) and after five weeks (black bars: seedlings eight weeks old at beginning of experiment, stippled bars: seedlings four weeks old at beginning of experiment). -- A: *Artemisia santonicum* from Czechoslovakia. -- B--E: *A. maritima* from Skåne, Sweden (B), Öland, Sweden (C), Bohuslän, Sweden (D), and Nordfriesland, Germany (E).



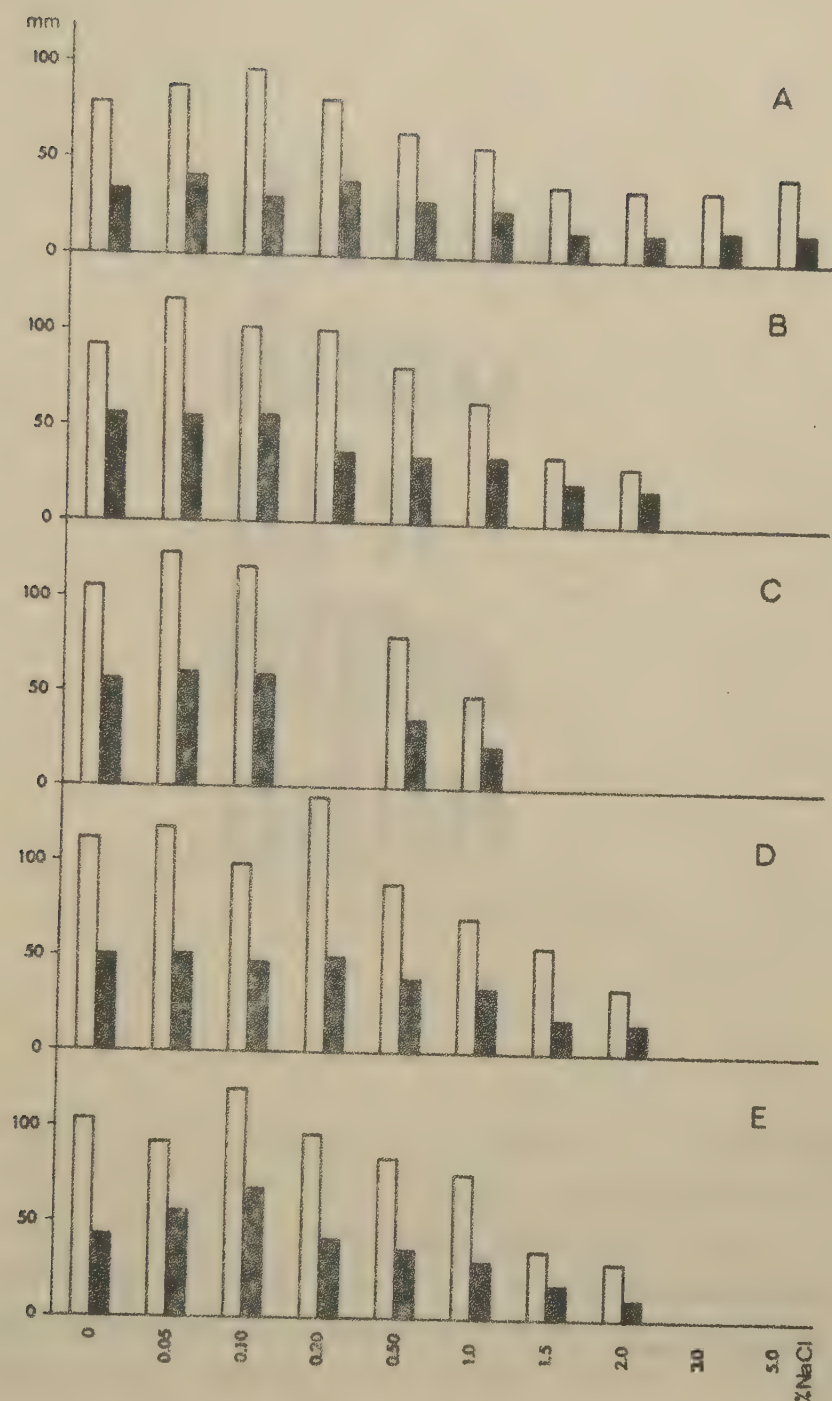


Fig. 94. Leaf length (white bars) and breadth of leaf lamina (black bars) in seedlings after five weeks in different concentrations of sodium chloride. Seedlings eight weeks old at beginning of experiment. -- A: *Artemisia santonicum* from Czechoslovakia. -- B--E: *A. maritima* from Skåne, Sweden (B), Öland, Sweden (C), Bohuslän, Sweden (D), and Nordfriesland, Germany (E).

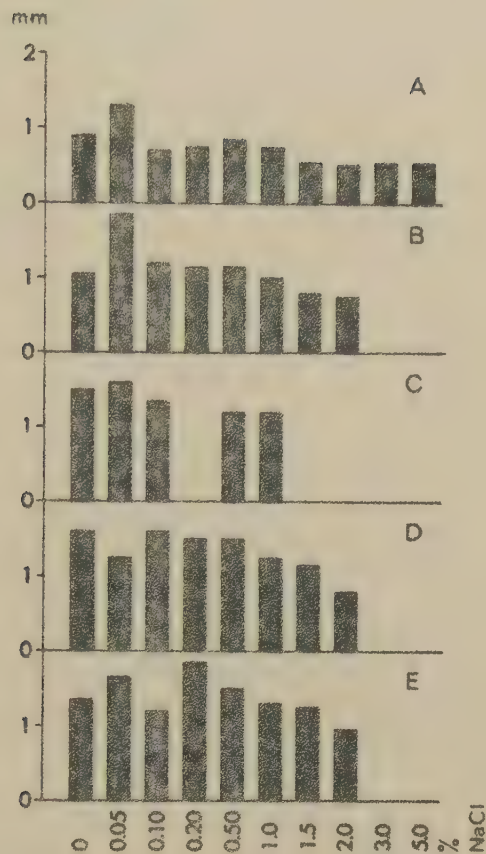


Fig. 95. Breadth of secondary leaf segments in seedlings after five weeks in different concentrations of sodium chloride. Seedlings eight weeks old at beginning of experiment. -- A: Artemisia santonicum from Czechoslovakia. -- B--E: A. maritima from Skåne, Sweden (B), Öland, Sweden (C), Bohuslän, Sweden (D), and Nordfriesland, Germany (E).

Fig. 96. Leaves of 13-week-old seedlings grown for five weeks in different concentrations of sodium chloride. -- A: Artemisia santonicum from Czechoslovakia. -- B--E: A. maritima from Skåne, Sweden (B), Öland, Sweden (C), Bohuslän, Sweden (D), and Nordfriesland, Germany (E).



Fig. 96.

Fig. 96. Leaves of 13-week-old seedlings grown for five weeks in different concentrations of sodium chloride. -- A: Artemisia santonicum from Czechoslovakia. -- B--E: A. maritima from Skåne, Sweden (B), Öland, Sweden (C), Bohuslän, Sweden (D), and Nordfriesland, Germany (E).

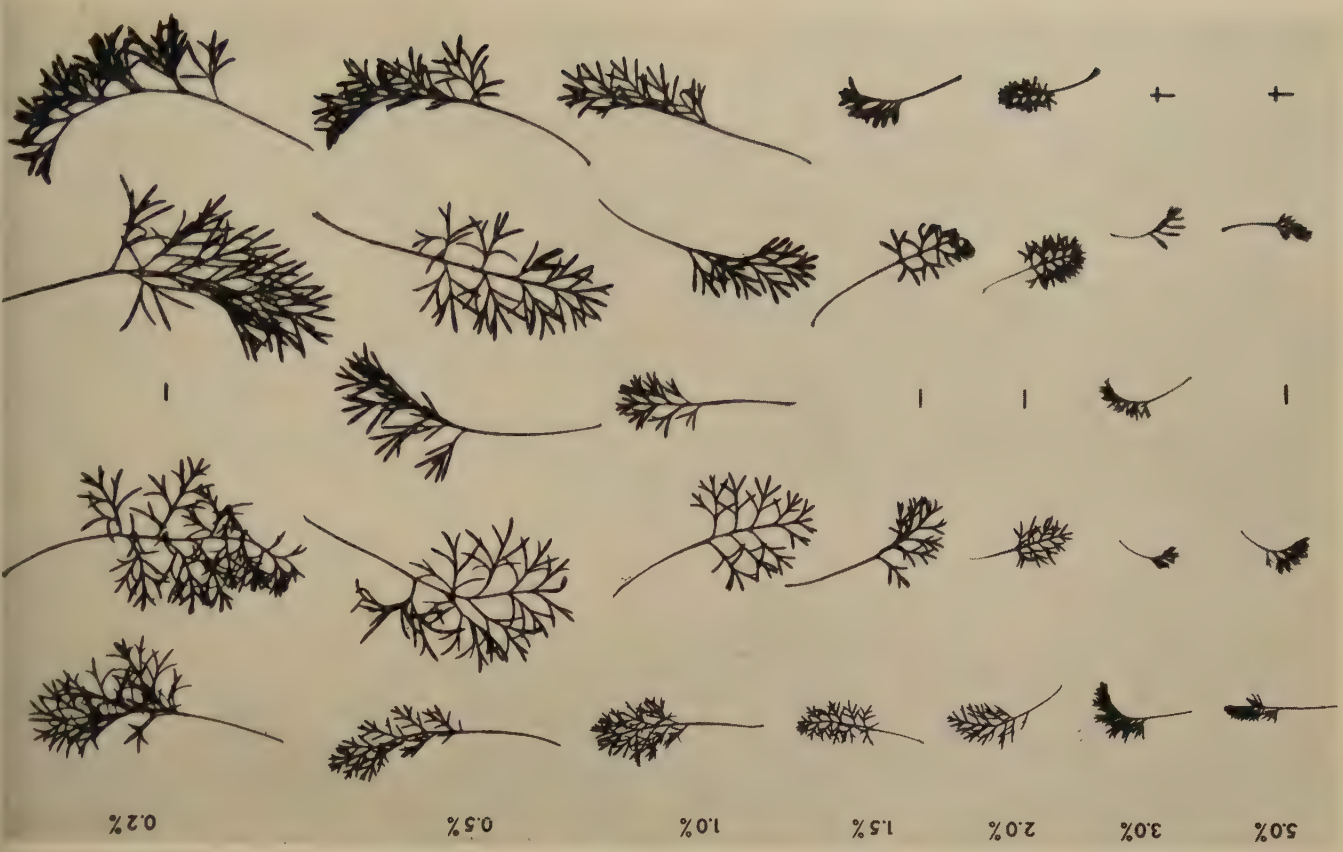


Fig. 96.

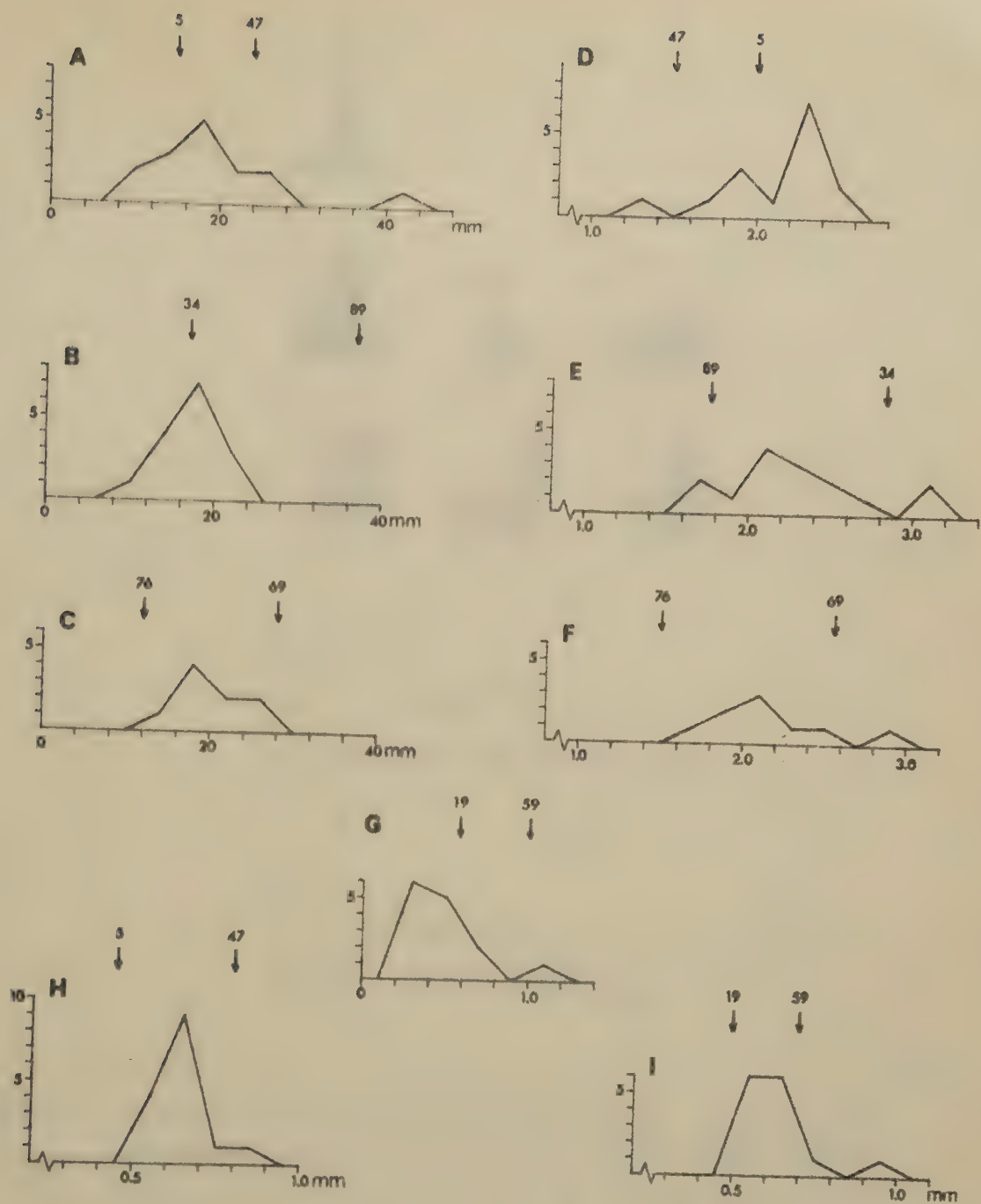


Fig. 97. Crosses within *Artemisia maritima*. Morphology of hybrid plants as compared with their parents (arrows). -- A--C: length of leaf lamina. -- D--F: leaf lamina length/primary segment length ratio. -- G: degree of leaf segmentation (number of segments on primary segment/length of primary segment). -- H--I: breadth of secondary leaf segments. -- Parent populations: no. 5: Gotland (Sweden), no. 19: Skåne (Sweden), no. 34: Halland (Sweden), no. 47: Bohuslän (Sweden), no. 59: north-eastern Jylland (Denmark), no. 69: Nordfriesland (Germany), no. 76: Ostfriesland (Germany), no. 89: Bohuslän (Sweden). -- On vertical axis number of plants.

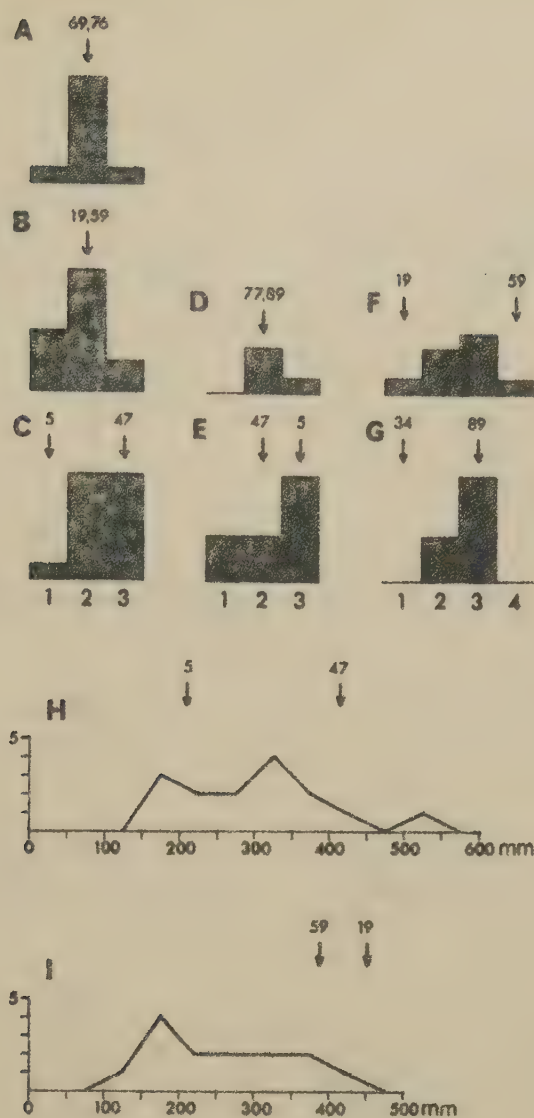


Fig. 98. Crosses within *Artemisia maritima*. Morphology of hybrid plants as compared with their parents (arrows). -- A--C: degree of suffrutescence (1 slightly, 2 moderately, 3 strongly suffrutescent). -- D--E: degree of branch rigidity (1 branches wholly pendent, 2 terminal parts of branches drooping, 3 branches erect). -- F--G: position of capitula on branches (1 unilateral position, 2 mixed condition, more like 1, 3 mixed condition, more like 4, 4 multilateral position). -- H--I: shoot length. -- Parent populations: no. 5: Gotland (Sweden), no. 19: Skåne (Sweden), no. 34: Halland (Sweden), no. 47: Bohuslän (Sweden), no. 59: north-eastern Jylland (Denmark), no. 69: Nordfriesland (Germany), no. 76 & 77: Ostfriesland (Germany), no. 89: Bohuslän (Sweden). -- On vertical axis number of plants.

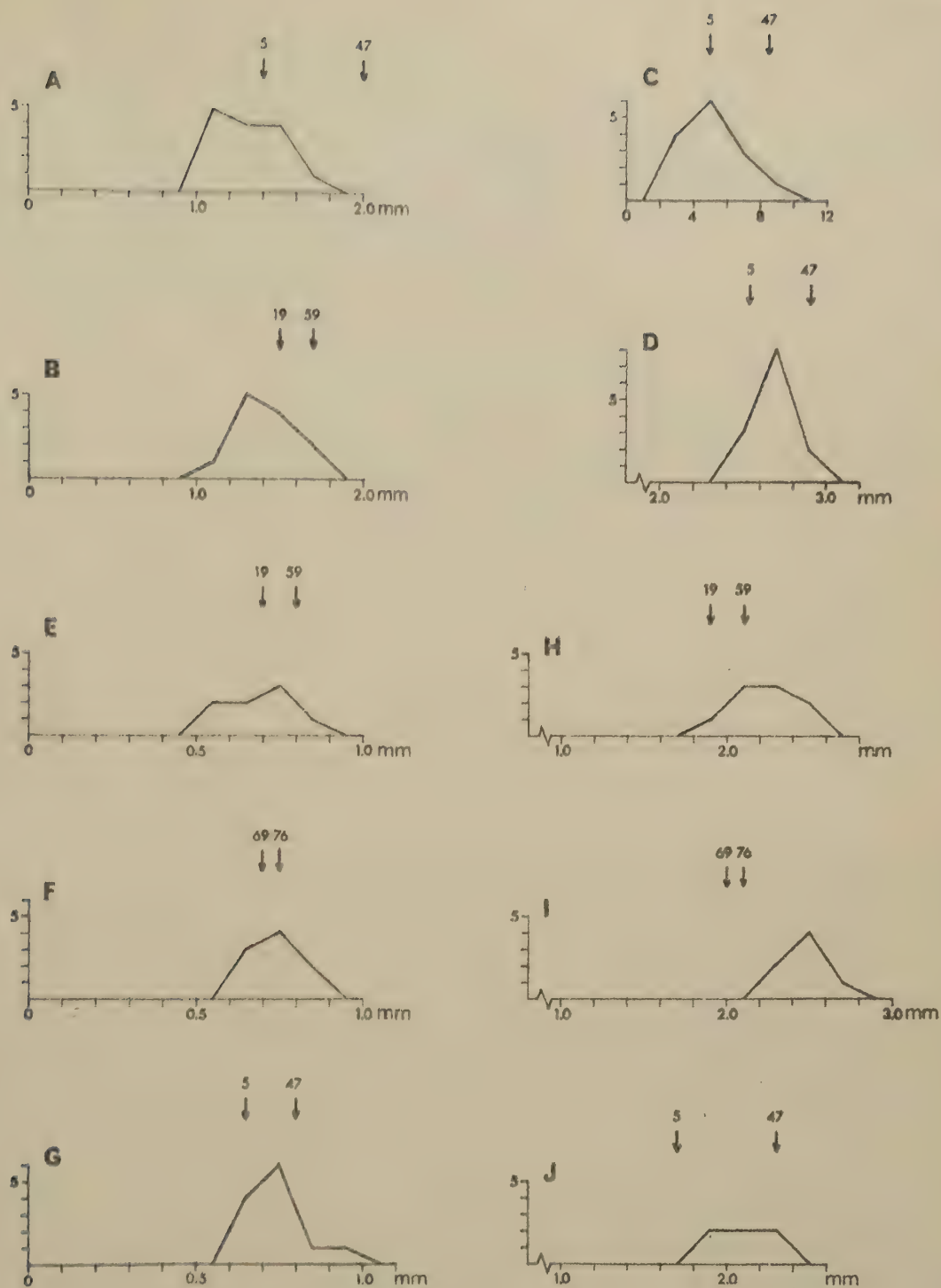


Fig. 99. Crosses within *Artemisia maritima*. Morphology of hybrid plants as compared with their parents (arrows). -- A--B: breadth of inner phyllaries. -- C: number of florets per capitulum. -- D: corolla length. -- E--G: length of style branch. -- H--J: achene length. -- Parent populations: no. 5: Gotland (Sweden), no. 19: Skåne (Sweden), no. 47: Bohuslän (Sweden), no. 59: north-eastern Jylland (Denmark), no. 69: Nordfriesland (Germany), no. 76: Ostfriesland (Germany). -- On vertical axis number of plants.

Fig. 100. Crosses within Artemisia maritima. F_2 plants of the cross no. 47 x 5 (B--G) and their parents (A: no. 5, Gotland; H: no. 47, Bohuslän). -- $X\frac{1}{2}$.

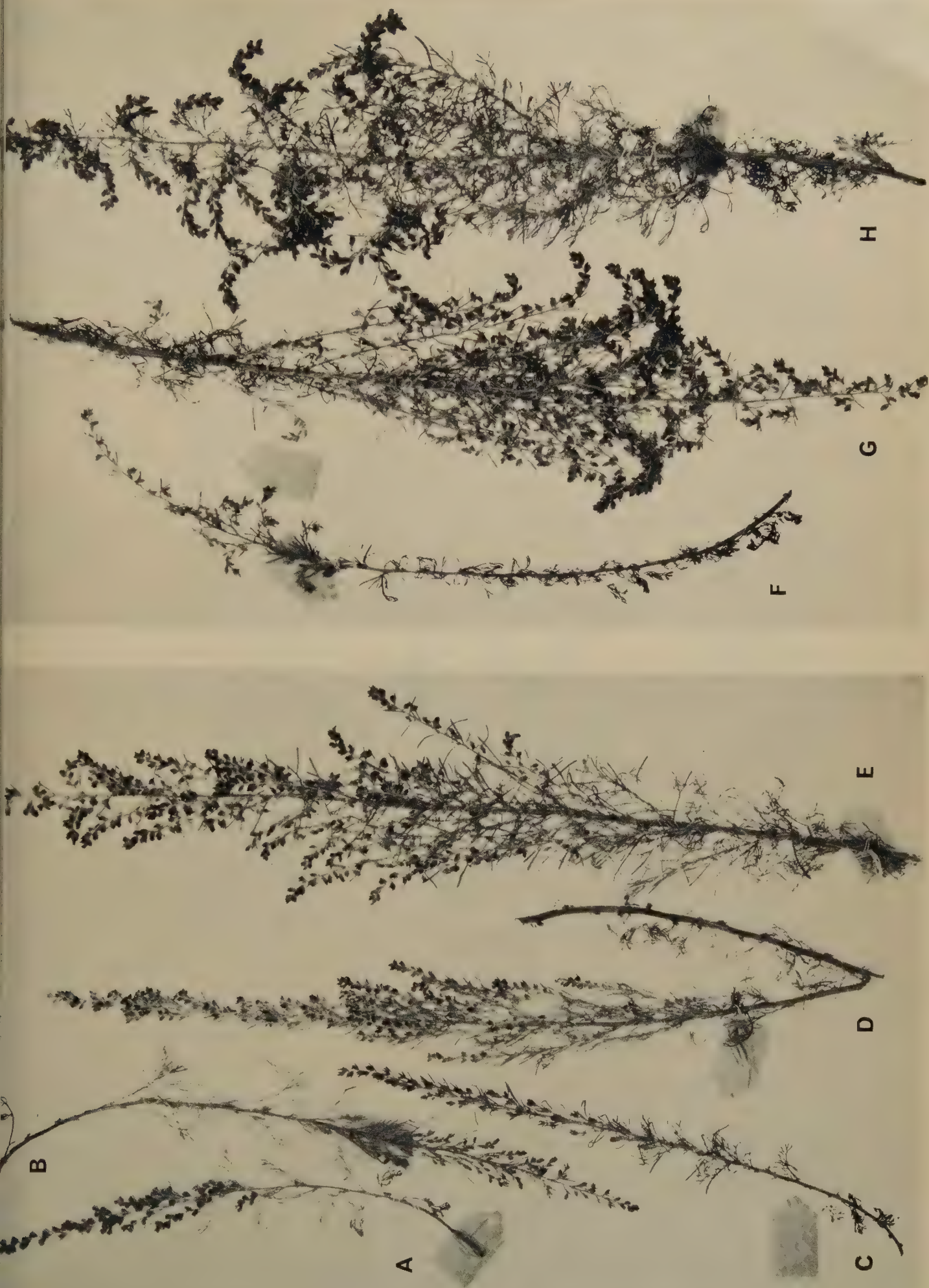


Fig. 100.



Fig. 101. Distribution of Artemisia maritima. -- A: whole distribution. -- B: North European distribution. Left of the dashed line: ssp. maritima, right: ssp. humifusa. -- The maps are based on the author's own collections and the herbarium specimens examined. Unfilled rings represent localities where the species has been reported but has not been refound by the present author.



Fig. 102. *Artemisia maritima* ssp. *maritima*, the West Swedish form series (A: Bohuslän, Nordkoster; B: Halland, Galtabäck). -- $\times \frac{3}{4}$



Fig. 103. Artemisia maritima ssp. maritima, the Baltic form series (Sweden, Skåne, Limhamn). -- $\times \frac{3}{4}$

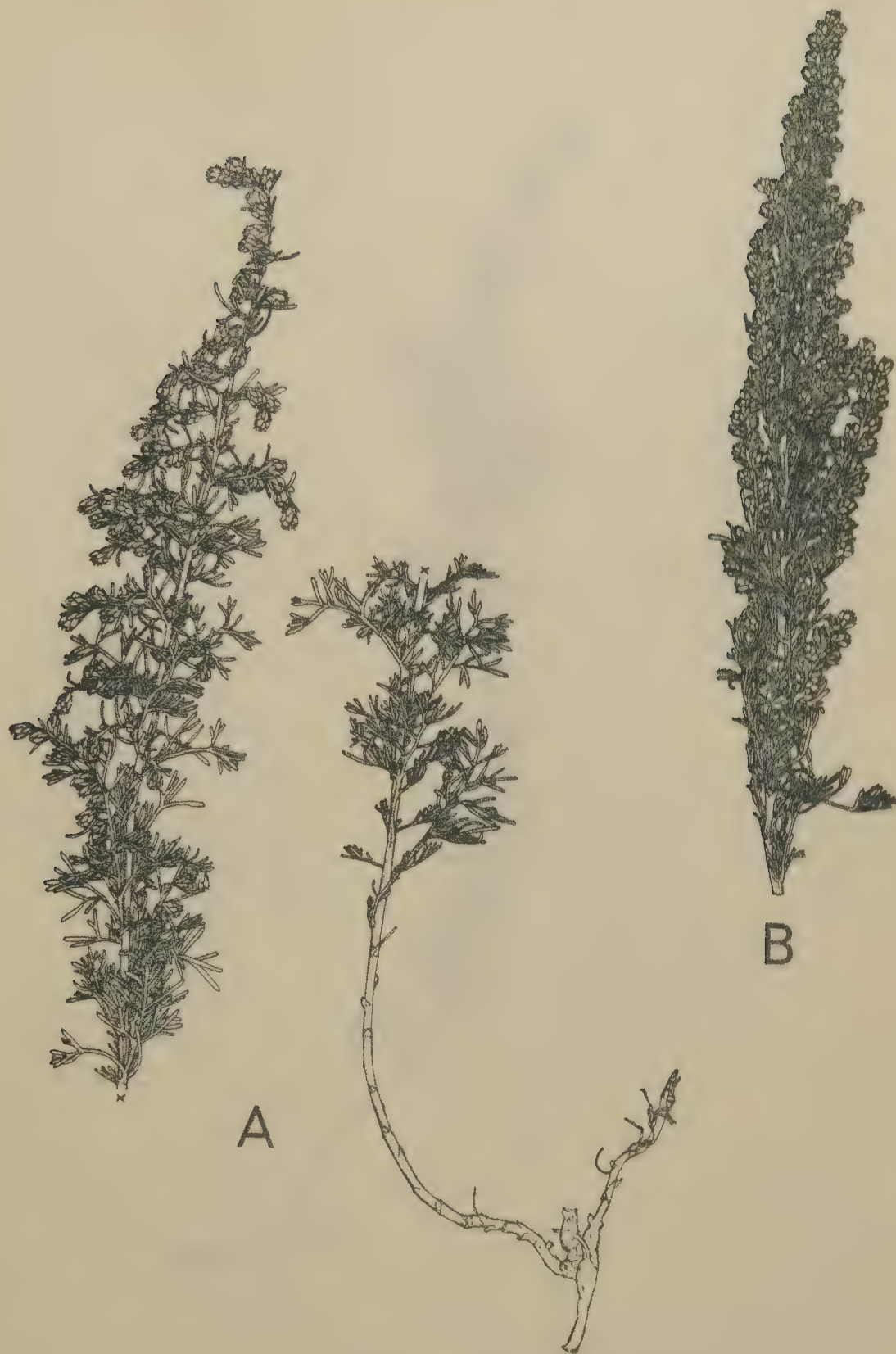


Fig. 104. Artemisia maritima ssp. maritima, the North Sea form series (A: Germany, Butjadingen, Langwarden; B: the Netherlands, Noord Holland, Marken). In B only the suffrutescence is illustrated. -- $\times \frac{3}{4}$.



Fig. 105. Artemisia maritima ssp. maritima, the French form series (France, Somme, St. Valéry). -- $\times \frac{3}{4}$.

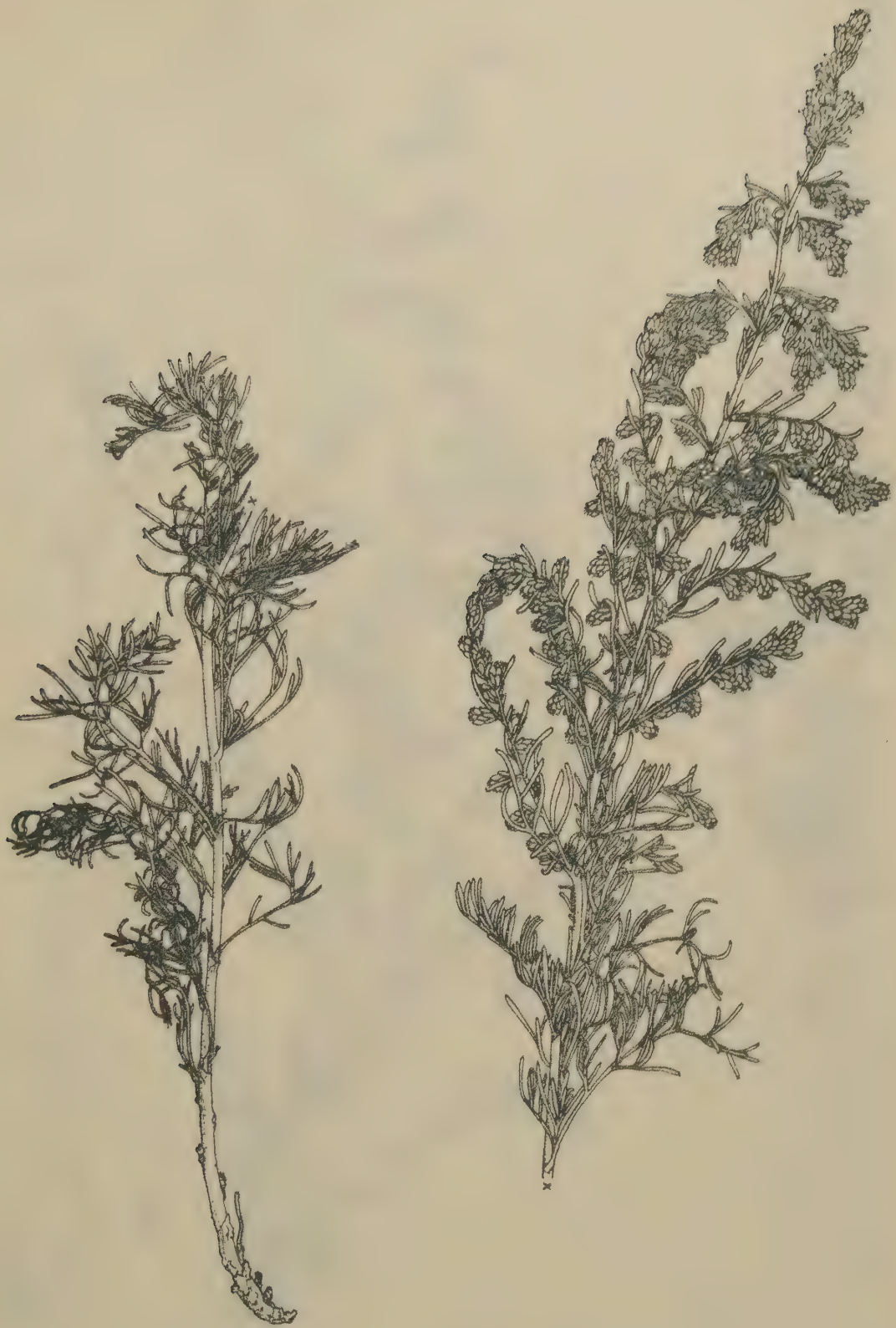


Fig. 106. Artemisia maritima ssp. maritima, the British form series (England, Suffolk, Southwold). -- $\times \frac{3}{4}$.

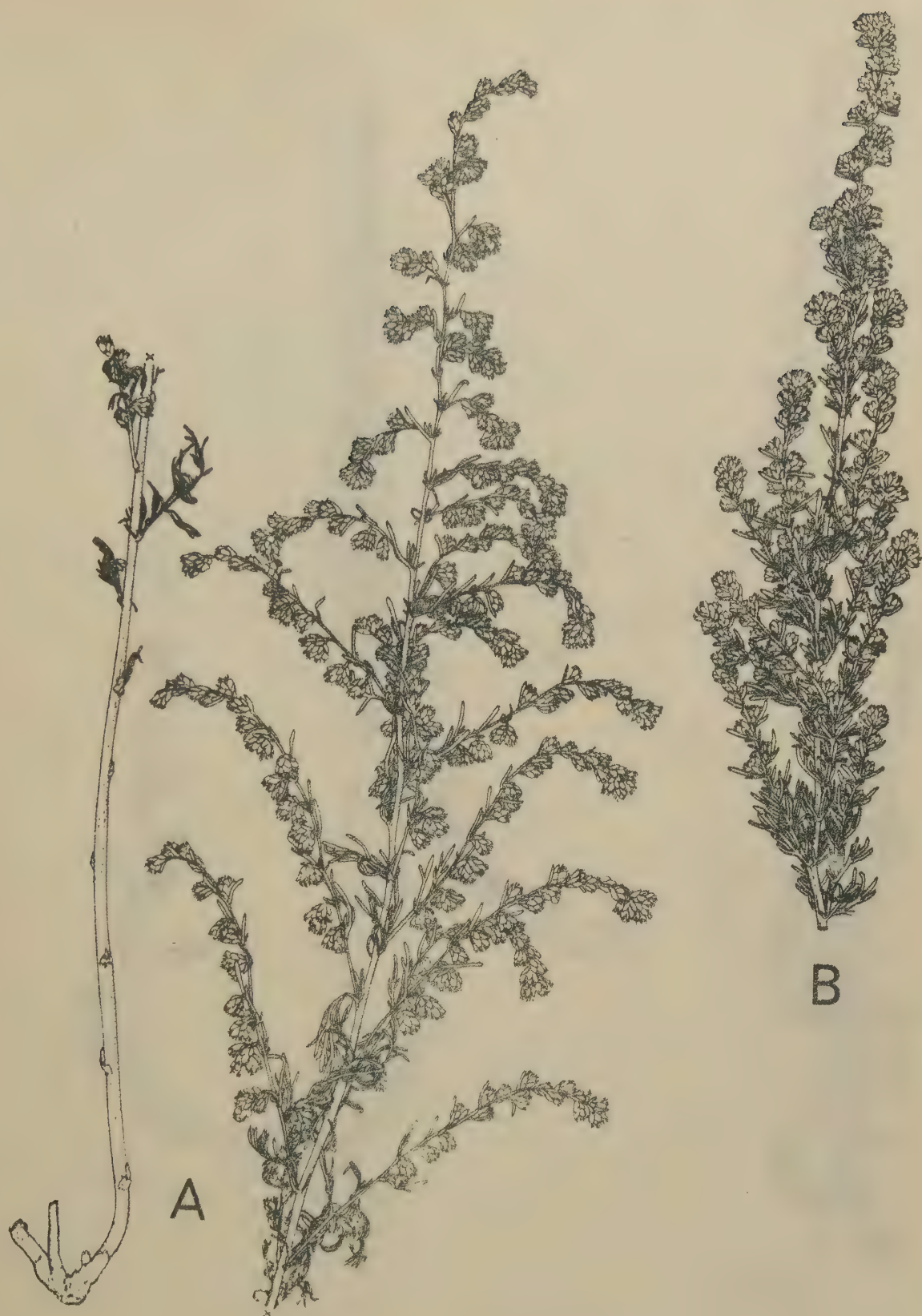


Fig. 107. Artemisia maritima ssp. maritima, the Inland form series (Germany, Artern). In B only the synflorescence is illustrated. -- $\times \frac{3}{4}$.

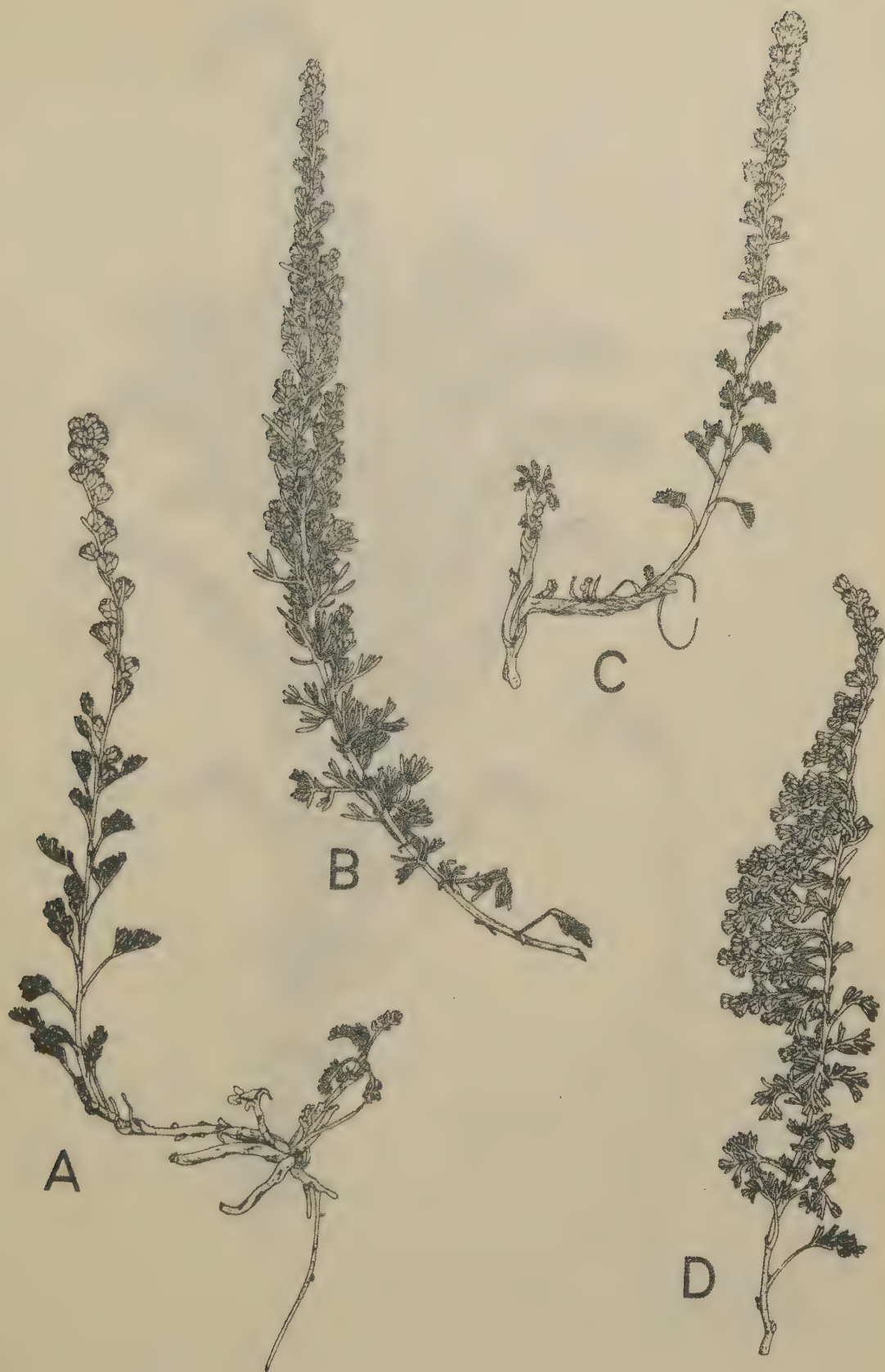


Fig. 108. Artemisia maritima ssp. humifusa (A: Estland, Saarema, Eriksaare; B: Sweden, Öland, Källahamn; C: Sweden, Gotland, Vivesholm; D: Sweden, Gotland, Grötlingbo). -- $\times \frac{3}{4}$.



Fig. 109. Artemisia maritima ssp. humifusa (Sweden,
Gotland, Ronehamn). -- $x\frac{3}{4}$.



Fig. 110. Distribution of Artemisia vallesiaca.

-- The map is based on the author's own collections and the herbarium specimens examined. -- 0.5 cm = 10 km.

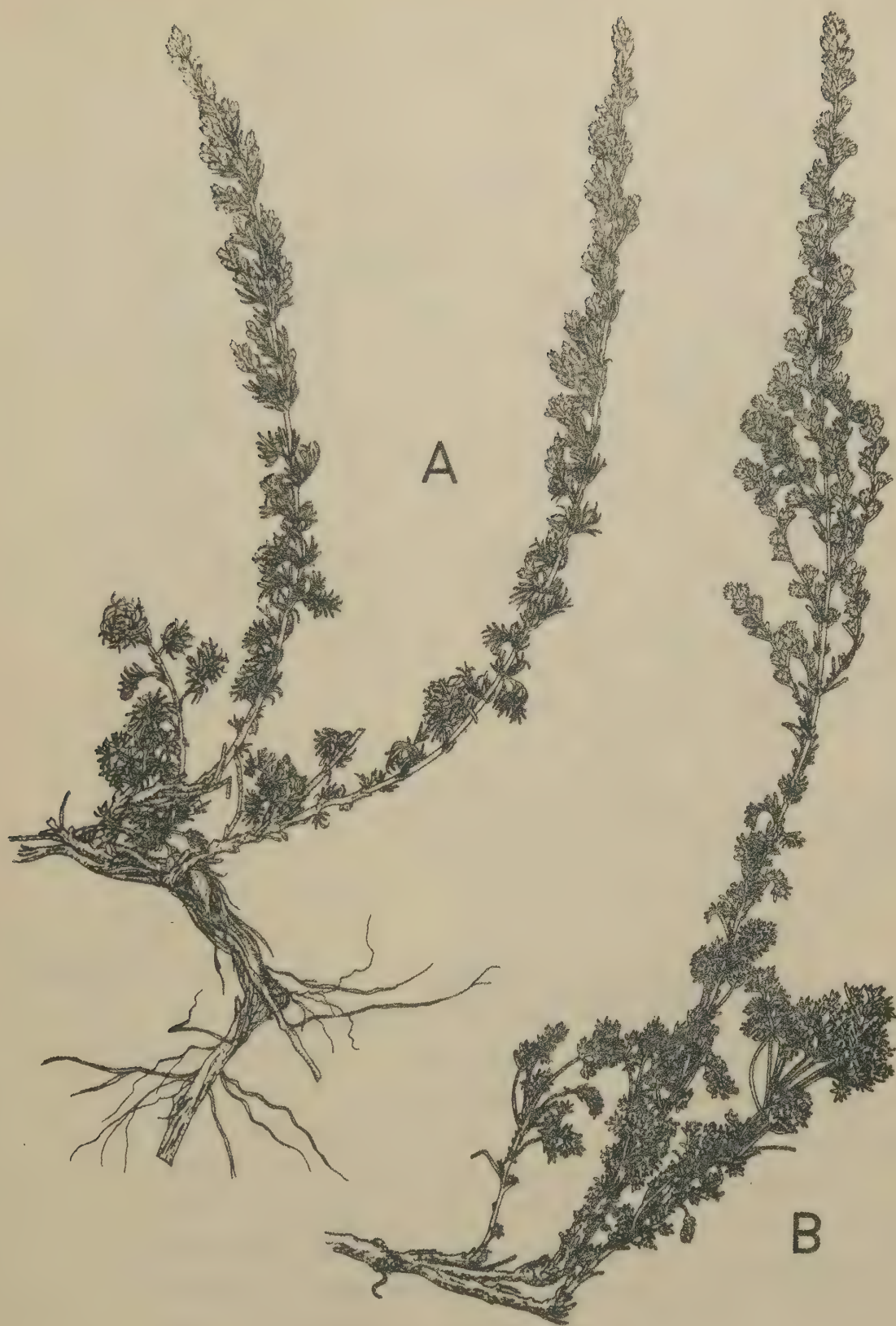


Fig. 111. Artemisia vallesiaca (A: Italy, Piemonte, Aosta; B: Switzerland, Valais, Sion). -- $\times \frac{3}{4}$.



Fig. 112. Distribution of Artemisia santonicum. Filled rings: ssp. santonicum; unfilled rings: ssp. patens; half filled rings: localities with both subspecies; crosses: localities where the plants have not been determined as to subspecies; arrows: localities of plants cytologically examined by the author. -- The map is based on the author's own collections and the herbarium specimens examined. Ssp. santonicum is also found in steppe and semi-desert areas in the southern part of European Russia, in Ciscaucasia and Dagestan. -- 1 cm = 100 km.

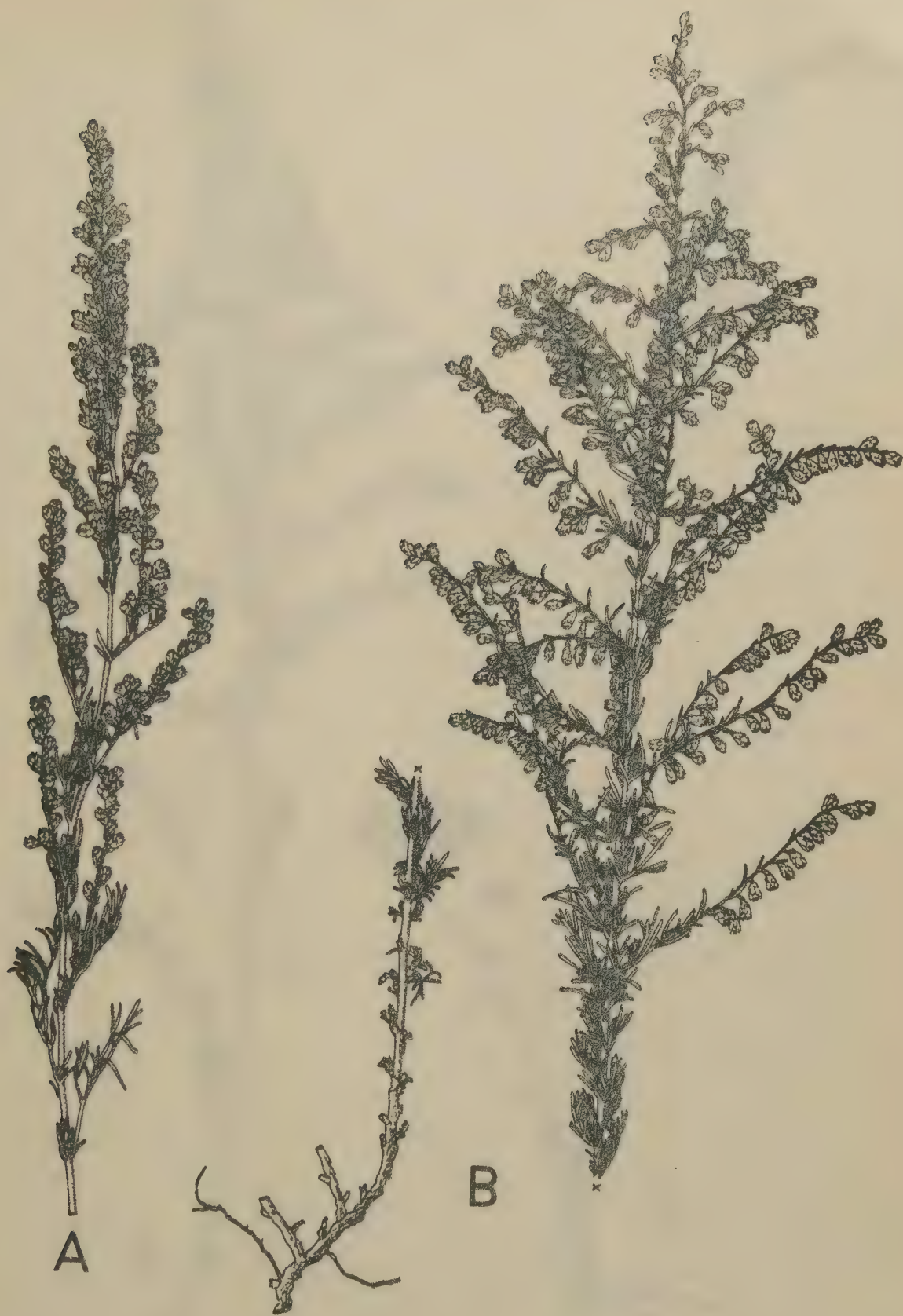


Fig. 113. Artemisia santonicum ssp. santonicum (A: Roumania, Cluj, Turda; B: Roumania, Iași, Sărătură; both probably tetraploids). In A only the synflorescence is illustrated. -- $\times \frac{3}{4}$.

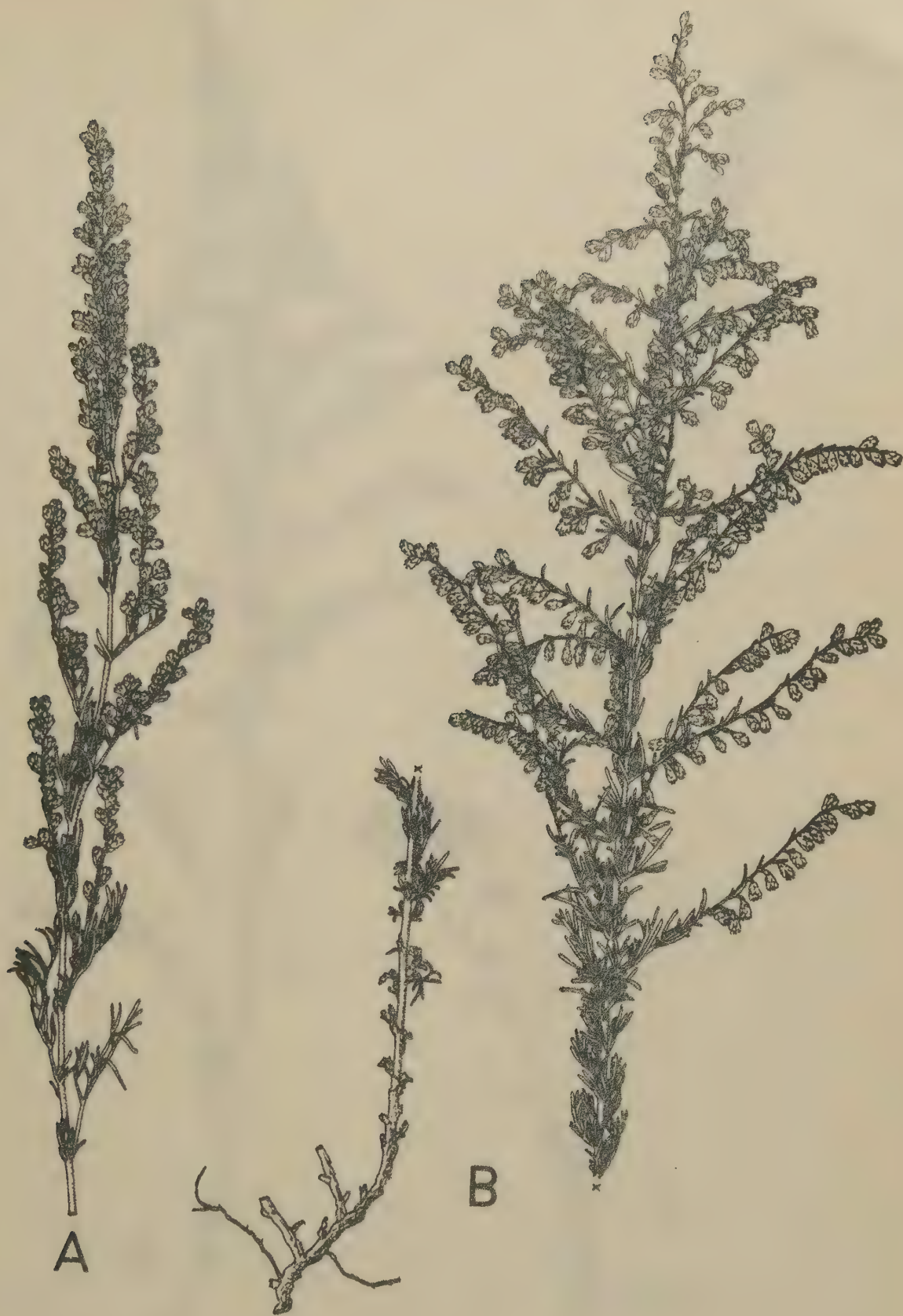


Fig. 113. Artemisia santonicum ssp. santonicum (A: Roumania, Cluj, Turda; B: Roumania, Iași, Sărătură; both probably tetraploids). In A only the synflorescence is illustrated. -- $\times \frac{3}{4}$.

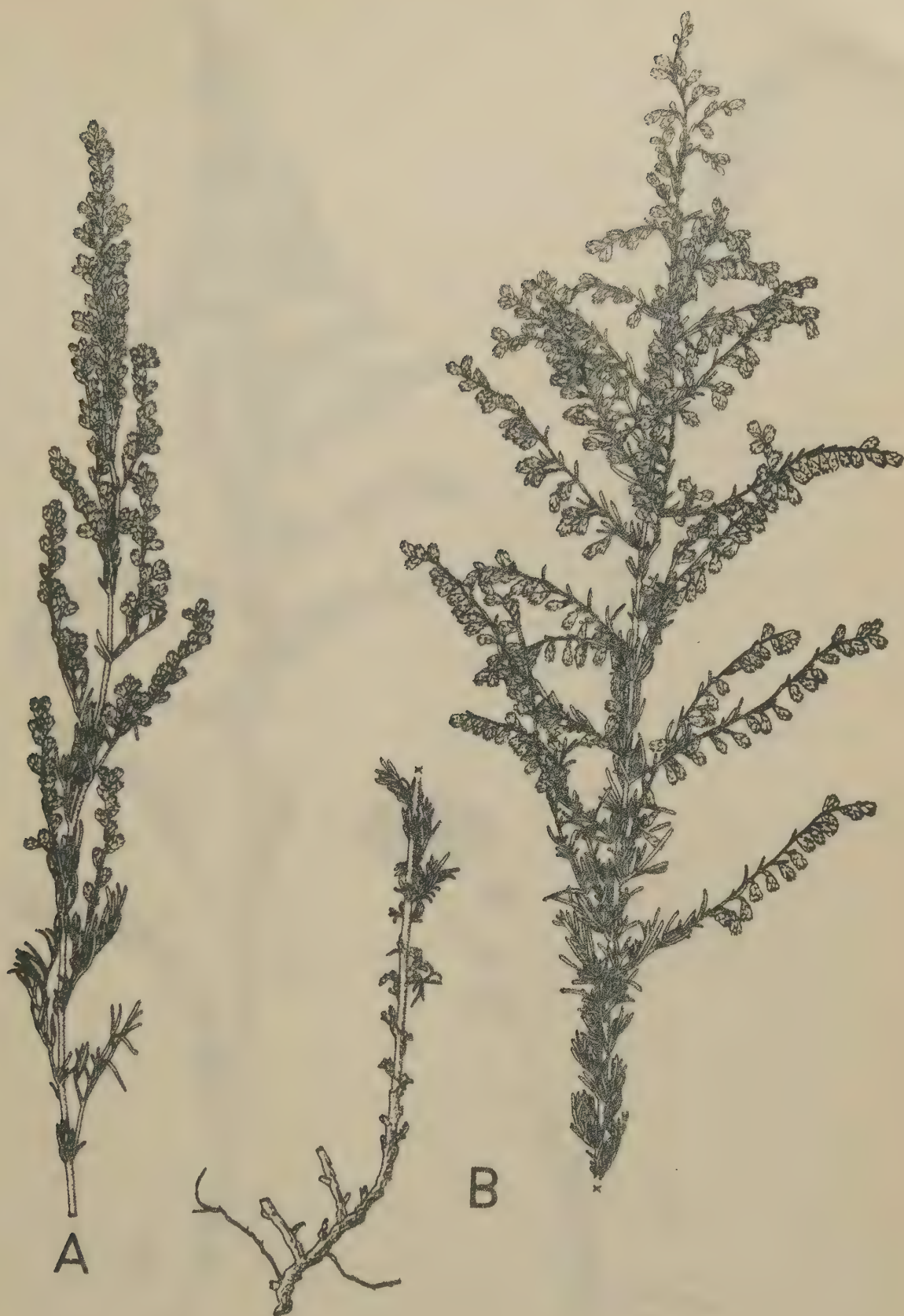


Fig. 113. Artemisia santonicum ssp. santonicum (A: Roumania, Cluj, Turda; B: Roumania, Iași, Sărătură; both probably tetraploids). In A only the synflorescence is illustrated. -- $\times \frac{3}{4}$.



Fig. 113. Artemisia santonicum ssp. santonicum (A: Roumania, Cluj, Turda; B: Roumania, Iași, Sărătură; both probably tetraploids). In A only the synflorescence is illustrated. -- $\times \frac{3}{4}$.

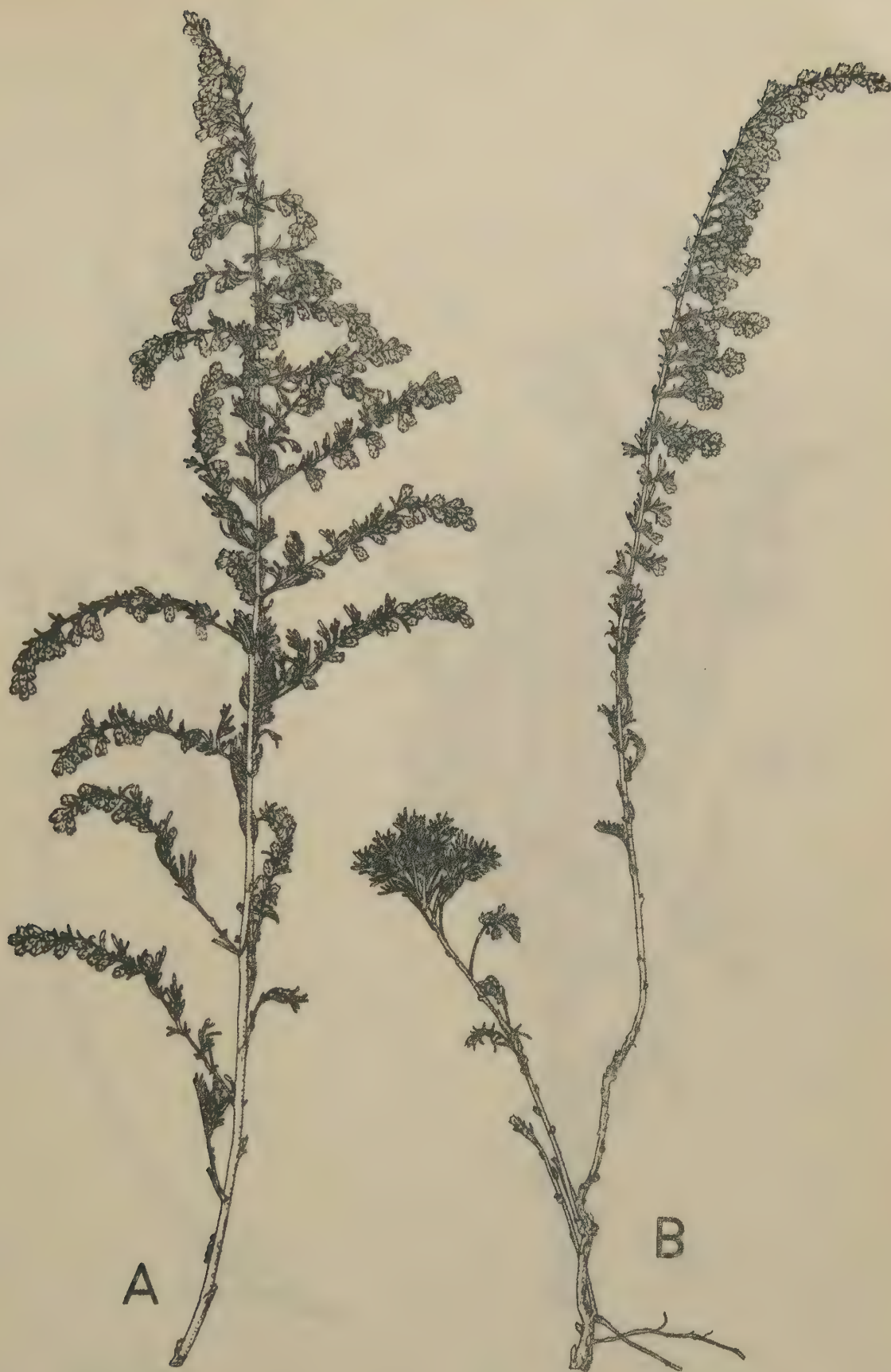


Fig. 114. Artemisia santonicum ssp. santonicum (A: Greece, Thraki, Porto Lago; hexaploid) and ssp. patens (B: Austria, Burgenland, Langelacke). In A only the synflorescence is illustrated. -- $\times \frac{3}{4}$.

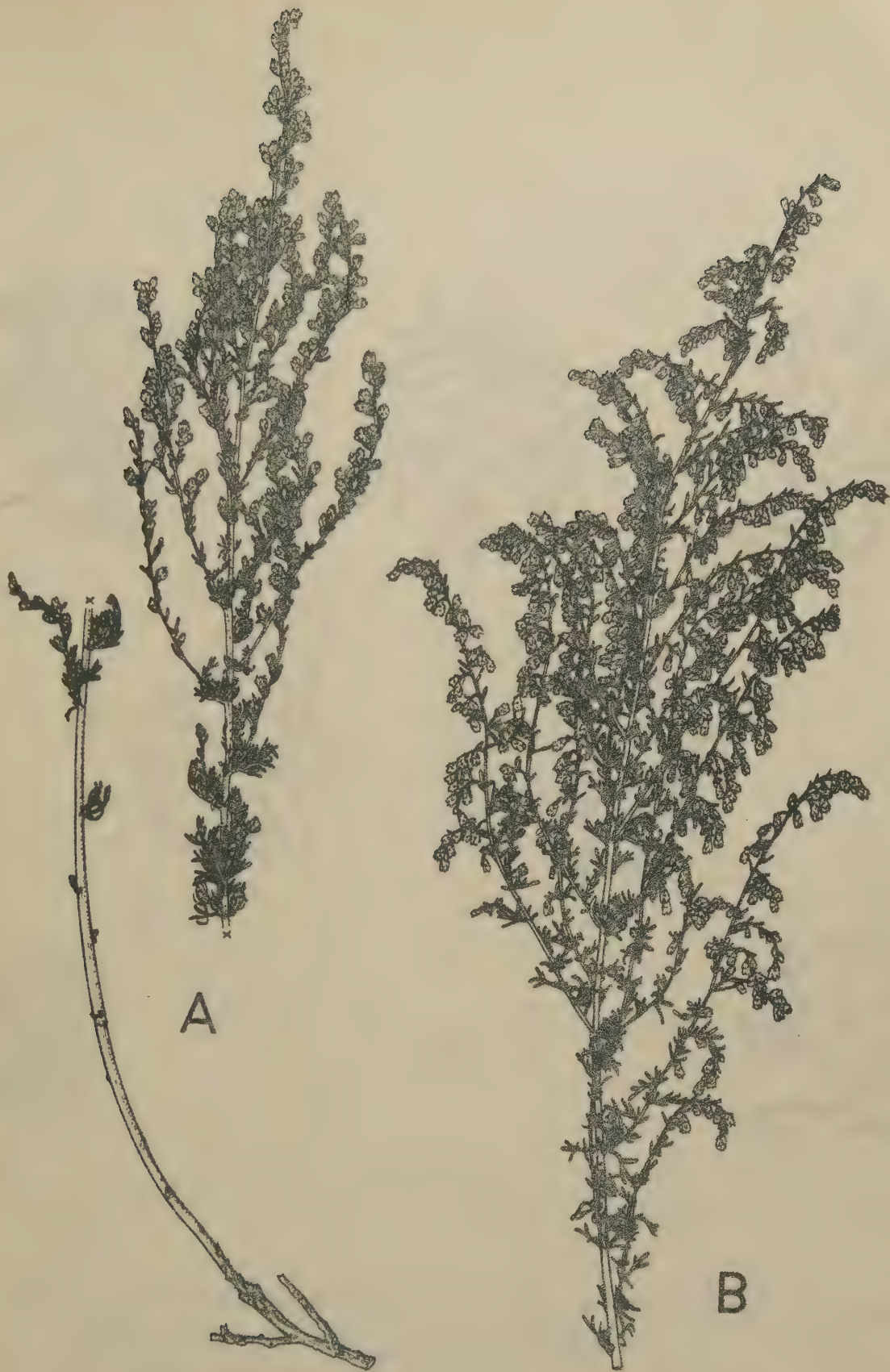


Fig. 115. *Artemisia santonicum* ssp. *patens* (A: Austria, Burgenland, Langelacke; B: Austria, Niederösterreich, Baumgarten). In B only the synflorescence is illustrated. -- $\times \frac{3}{4}$.

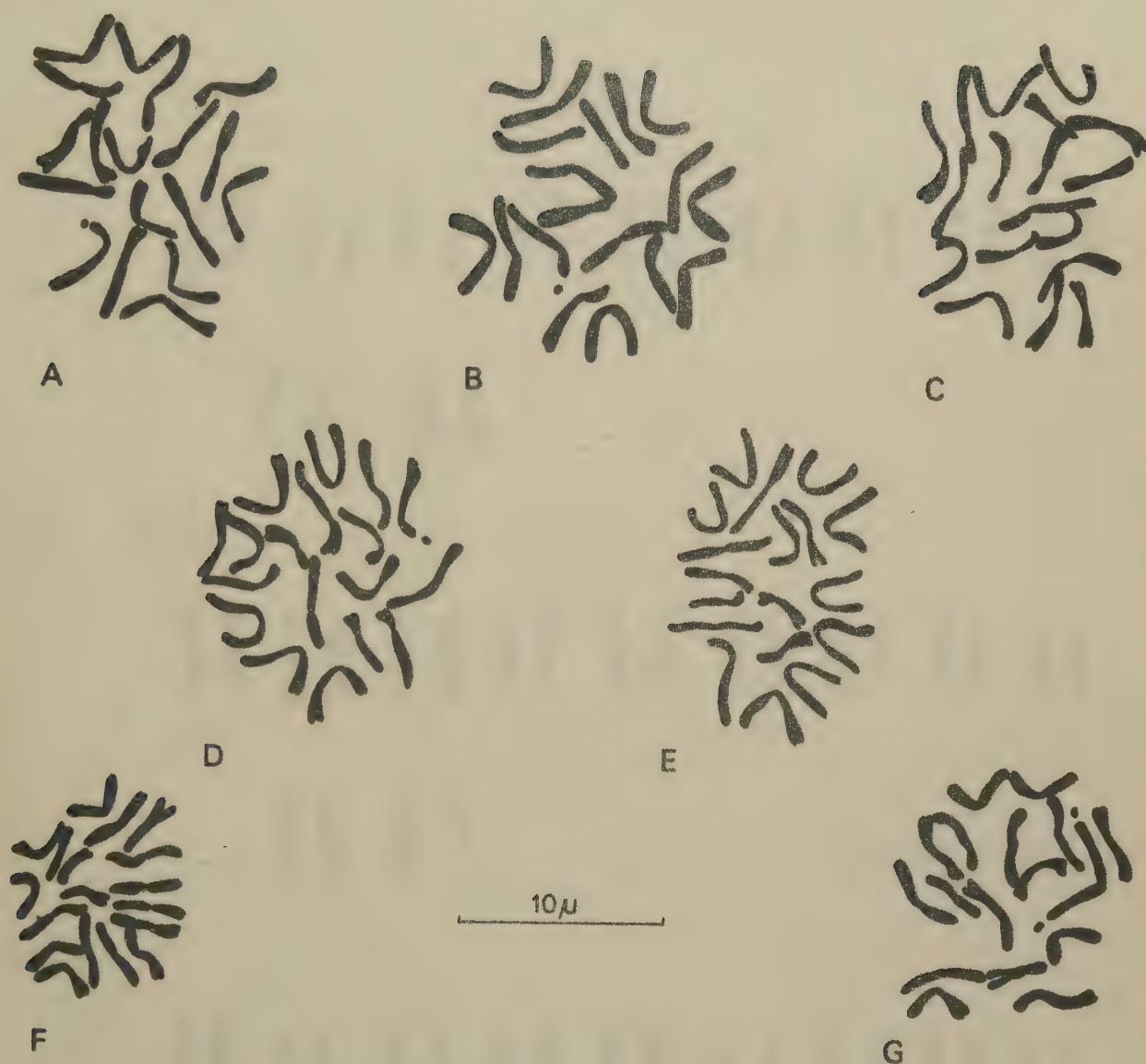


Fig. 116. Root-tip mitoses (microtome-cut preparations) in Artemisia gallica (A--B) and A. caerulescens (C--G). Localities: A: Aude, France (no. 142-3-1). -- B: Bouches du Rhone, France (no. 146-10-1). -- C--D: Algarve, Portugal (nos. 135-1-1 and 136-3-1). -- E--G: Istra, Yugoslavia (nos. 43-10-2, 44-1-2 and 44-2-1).

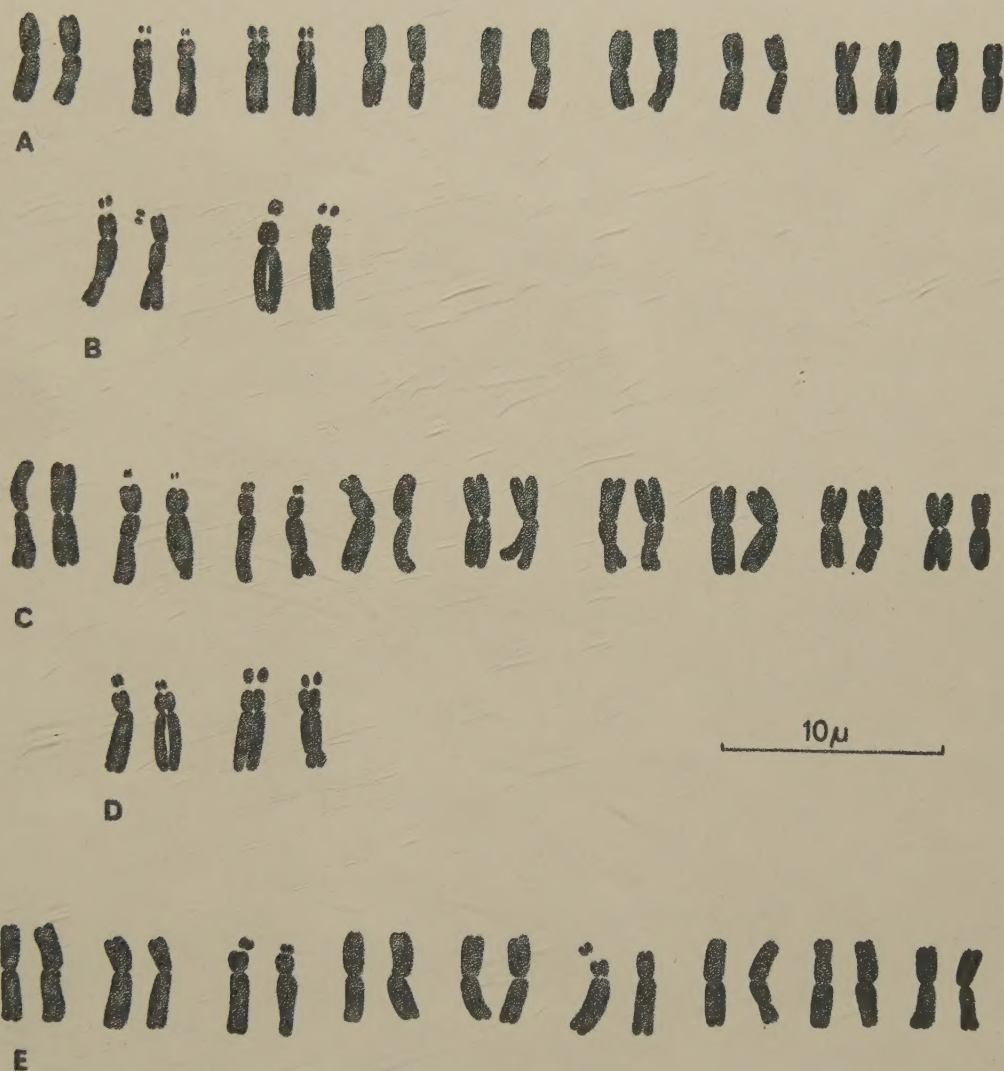


Fig. 117. Karyotype in *Artemisia gallica* (A--B) and *A. caerulescens* (C--E). In B and D only the satellited chromosomes are illustrated. -- A: plant no. 140-2-1 (Aude, France). -- B: plant no. 143-2-1 (Hérault, France). -- C: plant no. 134-9-1 (Lisboa, Portugal). -- D: plant no. 136-3-1 (Algarve, Portugal). -- E: plant no. 44-2-4 (Istra, Yugoslavia).

Fig. 117. Karyotype in *Artemisia gallica* (A-B) and *A. caespitescens* (C-E). In B and E only the satellited chromosomes are illustrated. -- A: plant no. 140-2-1 (Aude, France). -- B: plant no. 143-2-1 (Hérault, France). -- C: plant no. 144-2-1 (Lisboa, Portugal). -- D: plant no. 145-2-1 (Algarve, Portugal). -- E: plant no. 44-2-4 (Istra, Yugoslavia).

